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PATTERNS OF GROUNDWATER FLOW, pH, AND ELECTRICAL CONDUCTANCE IN THE NORDIC WEST ARM TAILINGS, ELLIOT LAKE, ONTARIO

CONTRACT REPORT NO. 05L80-00123

FINAL REPORT

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1. INTRODUCTION

1.1 Objective Of The Field Investigation

The prime objective of the field investigation reported on herein was to install a groundwater monitoring network in and below the West Arm Nordic Tailings in order to:

1. determine the general directions of groundwater flow within the tailings;

2. provide a basis for calculation of the groundwater flux into and out of the tailings;

3. provide a groundwater sampling network that will serve in water investigations of the variations or patterns in chemical composition of groundwater within the tailings.

1.2 General Site Description

The West Arm Nordic tailings area is located immediately west of Nordic Main tailings deposit and covers an area of 15 hectares. Both are located in bedrock depressions infilled with some glaciofluvial sands and sand and gravel till overlain in places by a layer of peat. Prior to the emplacement of the tailings, the West Arm area was a low-lying area with little relief and poor drainage. The tailings were emplaced in the West Arm after two dams were constructed to impound the tailings in the valley (Figure 1).

Surface water outlets are located at each dam in the form of a man-made drainage ditch constructed across the dams. In the east end the drainage ditch has intermittent water flow as a result of precipitation events. There appears to be little base flow into the drainage ditch. The west drainage

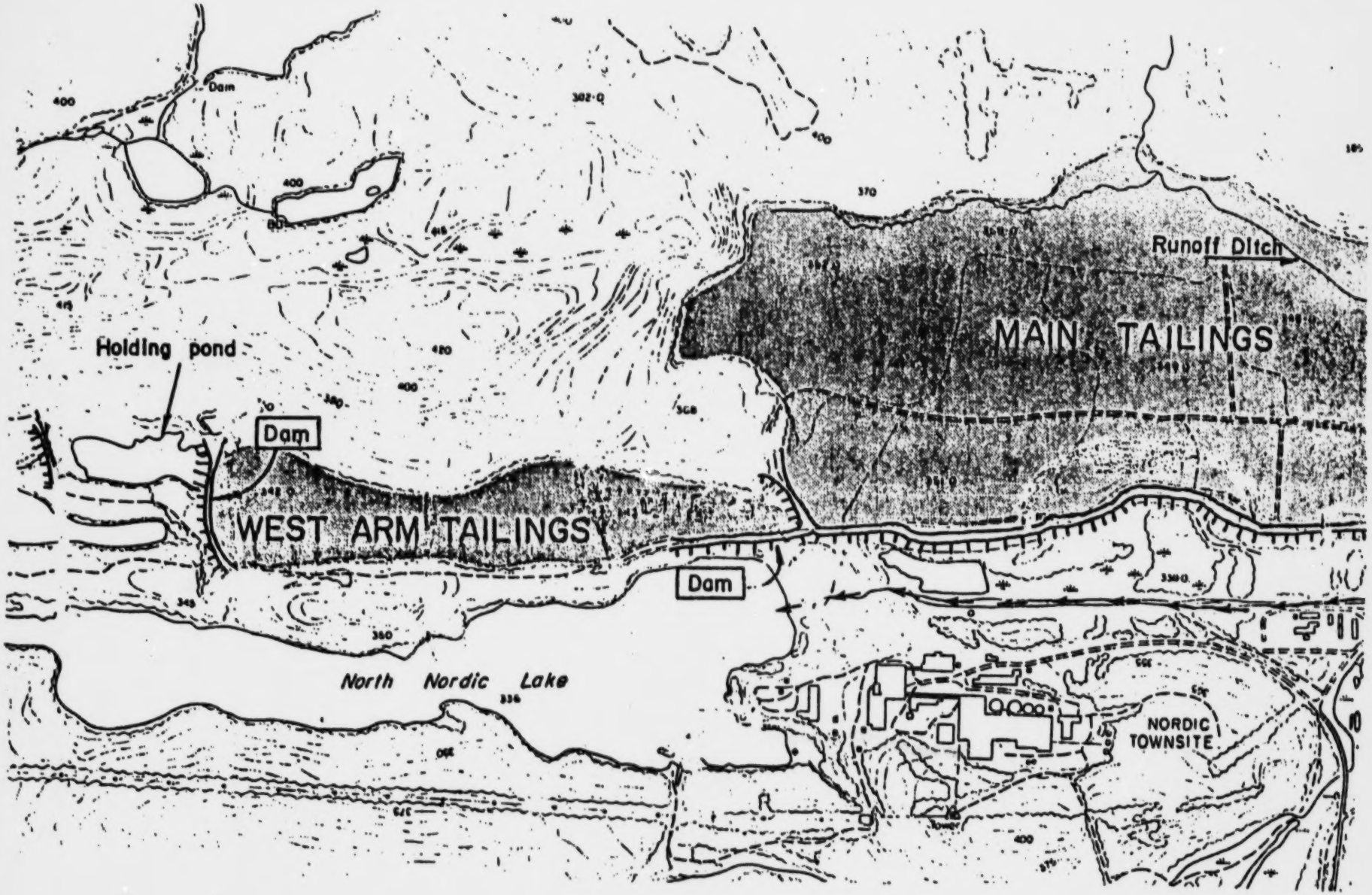

Figure 1 - General site setting Nordic West Arm tailings (after Morrison and Beatty, 1980).

ditch is above the water table and there is no surface water flow. A study carried out by Morrison and Beatty Ltd. (1980) describes the hydrologic budget of the area. Blair et al (1980) describe the mining process and manner of emplacement of the tailings.

2. METHODS OF INVESTIGATION

2.1 Installation of Piezometers

Piezometers were installed within the West Arm tailings and in the underlying unconsolidated deposits during two phases of drilling. During both phases no soil samples were taken, however, during drilling at each site the depth to the peat layer, the depth to the bouldery till and/or bedrock was recorded as well as the type of drill cuttings.

Piezometers installed in the tailings, peat layer, and the unconsolidated deposits immediately underlying the peat were a modified Casagrande drive-point piezometer designed by Blair et al. (1980) and constructed entirely of plastic material to avoid corrosion in acidic water (Figure 2). A porous polyethylene cartridge (Vyon) with a 50μ pore size was used for the piezometer screen The porous cartridge was found necessary to prevent the silt-sized tailings particles from entering the piezometer. The porous cartridge formed a sleeve over a 15 cm x 3.0 cm schedule 80 PVC perforated barrel. The porous cartridge was placed between the drive-point tip and a female coupling and sealed with a silicone compound.

The initial phase of drilling was carried out during late July and early August, 1980. Nine piezometer nests were installed during this phase of drilling with eight of these nests installed along an east-west section of the tailings as shown in Figure 3. Between three and seven piezometers were installed at each nest.

Twenty-seven piezometers were installed at five nests using a hand-operated, gasoline-powered percussion drill (Atlas-Copco "Cobra"). At each location the first piezometer point was advanced until advancement was halted. During advancement the tailings below the water table liquefy around the piezometer

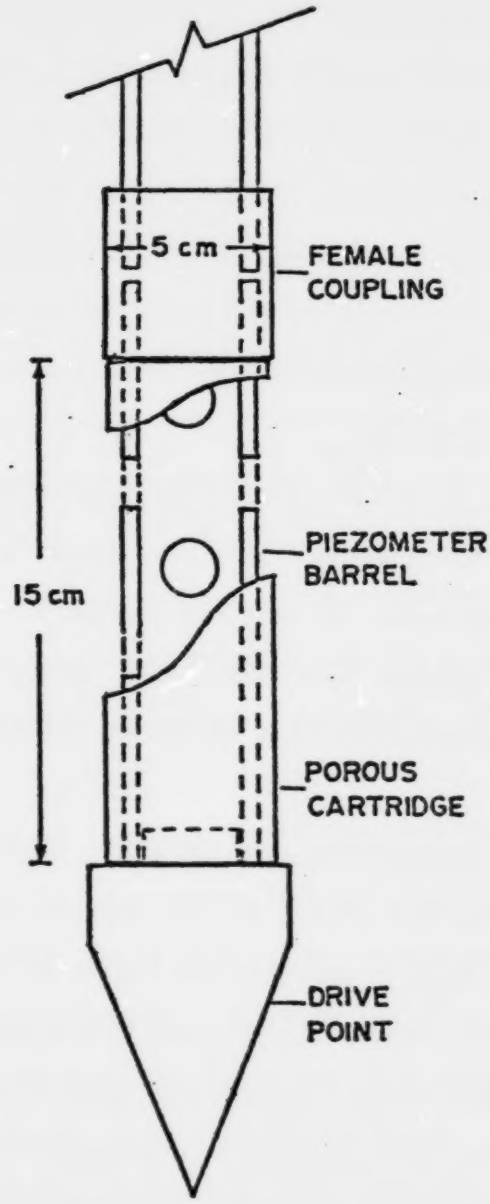

Figure 2 - Design of piezometer tips used in tailings (Blair et al, 1980).

pipe and afterwards settle back tightly around the piezometer pipe. The maximum advancement varied from site to site depending on the depth to the water table and the variations of grain-size in the tailings at each location. Each piezometer was advanced by driving 1.5m coupled sections of 3 cm schedule 40 PVC pipe. A steel driving mandrel formed an adaptor for the percussion drill and provided the rigidity for driving the PVC pipe. After the maximum advancement at each site was achieved piezometers were installed at one metre spacing to just below the water table.

A CME 55 hollow-stem auger drill mounted on a track-vehicle was used to install a piezometer below the peat layer at the above sites and to install piezometer nests where the percussion drill was unable to operate with success. Twenty-one piezometers were installed at four sites in the western area of the tailings where the water table is deeper and where the tailings are coarse-grained.

When piezometers were installed below the peat layer a drill plug and centre rods were used inside the hollow-stem augers in order to drill through the peat layer without plugging the inside of the augers. The plug was then removed and a piezometer placed inside the augers. The augers were then pulled out enabling the material to collapse around the piezometer pipe generally to a depth near the water table. A 0.3m seal was then placed above the collapsed material using bentonite gravel and measuring the depth to the bottom of the open hole. The open hole was then back filled with cuttings from the drilling. Piezometers in the tailings were installed inside the hollow stem auger without using a centre plug. Holes were drilled to approximately one metre above the depth the piezometer point was to be placed and driven down the remaining metre by hand. In this way the point was placed in tailings relatively undisturbed by the drilling.

The second phase of drilling was carried out in late August and early September after initial data was collected from the piezometer nests installed during the first phase of drilling. It was decided that due to the variability in data between sites a larger number of piezometer nests should be located off the main cross section. In order to install piezometers at a large number of sites the vertical spacing between piezometer tips was generally greater then one metre at these sites. Fifteen more nests were installed within the West Arm tailings to form a series of north-south cross sections and one main east-west cross section (Figure 3). One nest was installed in the main tailings on the eastern edge of the east-west cross section. Nests contained between two and six piezometers. Piezometers were installed as described in the first phase of drilling.

At five locations multilevel bundle-type piezometers were installed in the sand deposits beneath the tailings to provide for hydraulic head readings and for water sampling at one metre depth intervals. The multilevel assemblies were constructed of a bundle of 12mm (O.D.) polyethylene tubes with each tube having a 10cm screened interval at the end, fastened at one metre depth intervals to a central 12mm (I.D. PVC pipe). The multilevel bundles were installed using a CME 75 hollow stem auger drill mounted on a track vehicle. A seal was placed in the peat layer by wrapping wet bentonite around the multilevel bundle at the depth the peat layer was encountered to seal off possible hydraulic connections along the bundle due to the vertical gradients across the peat layer.

A complete description of the groundwater monitoring installations is given in Appendix A. Locations are shown in Figure 3.

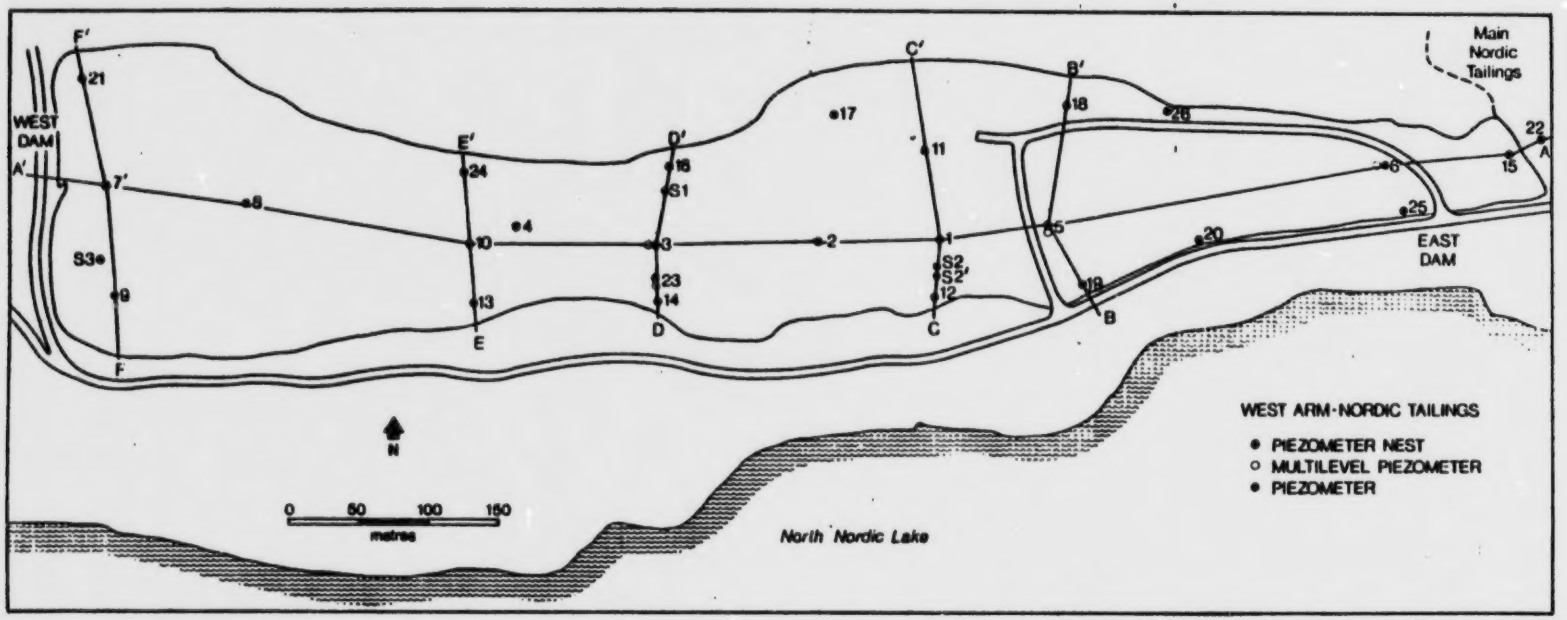

Figure 3 - Location Of Piezometers And Cross Sections In the West Arm Nordic Tailings.

2.2 Water Level Monitoring

From monitoring water-level data, groundwater flow directions and hydraulic gradients can be established over the tailings area. Using this information, with hydraulic conductivity information discussed in the next section, estimates of groundwater velocities and fluxes will be determined for the tailings area.

Water levels were monitored frequently during the entire field study period. This was done for two reasons. Firstly, it was necessary to determine when water levels in the piezometers were stabilized and secondly to observe groundwater response as a result of precipitation events.

Water levels were measured as depth below the top of the uncapped piezometer pipe. The tops of these pipes were surveyed relative to local bench mark. Water levels were measured using an Ott electric water-level meter in the large piezometers and using a coaxial-cable electric probe in the multi-level-bundle piezometers.

2.3 Piezometer Tests For Hydraulic Conductivity

Hydraulic conductivity tests were conducted in piezometers along a number of the cross-sections. These values are needed for calculation of representative groundwater velocities and fluxes using the Darcy equation.

Two methods were used to carry out these tests. Where material was reasonably coarse and a relatively high hydraulic conductivity was assumed slug tests were carried out. Slug tests were performed by lowering an aluminum rod of known volume below the static water level in the piezometer and measuring the water level response against time until equilibrium is reached. However when the

water level response was slow a second method was used, whereby the water column in the piezometer was pumped out and the depth to water monitored as recovery occurred. This is known as a rising-head test.

These tests give a measure of the hydraulic conductivity in the immediate vicinity of the piezometer tip. By testing a number of piezometers within the tailings, the spatial variability in the hydraulic conductivity can be estimated, and representative values for tailings of various textural types can be determined.

2.4 Field Measurement of Electrical Conductance and pH

Measurements of pH electrical conductance and temperature were made in the field on piezometer water samples to examine the variability in gross water chemistry within the tailings and to identify zones of contaminated water in the sandy aquifer below the tailings. These measurements were not meant to be part of a detailed geochemical survey but rather to obtain an initial indication of the areal extent and depth of acidification of the tailings pore water and of seepage zones in the underlying sand.

All piezometers were either pumped dry using a peristaltic pump or a hand-operated vacuum pump (Guzzler type). A volume of water greater than the standing water in the pipe was removed from each piezometer to ensure entry of fresh formation water into the piezometer. Measurements of electrical conductance were done on a number of water samples from each piezometer to determine if the measurements represented stabilized values. Temperature was measured at the same time. All measurements were made on fresh samples pumped into a 250mℓ beaker. The pH and conductance probes were placed separately into the beaker with care taken to ensure that the probes were not touching the sides or bottom of the beaker.

3. RESULTS

3.1 Groundwater Flow System

3.1.1 Water Table

The water table in the West Arm Nordic tailings varies from less than .5m below ground surface in the eastern portion to 2.5m below ground surface in the west end and the southern edge of the central portion of the tailings. Figure 4 shows the depth to the water table, September 7, 1980 after a period of relatively low precipitation. Figures 5 and 6 show the water-table configuration in the tailings before and after a precipitation event, respectively. The water-table configuration indicates that there is a component of groundwater flow away from the central portion of the tailings. There is a greater flow in the north-south direction in the eastern and central portion of the tailings. In the western segment of the tailings, horizontal gradients indicate flow in a westerly direction towards the west dam.

A comparison of the water-table configuration in Figures 5 and 6 shows that in areas where the water table is less than a metre below ground surface, a rapid response in the water table is seen during recharge events. Approximately 0.7cm of rain was recorded between September 8 and September 9. In areas of shallow water table, the recorded water-level rise was as much as 16cm (UW5) higher at the time the water levels were recorded. The rise may in fact have been greater because the measured rise may not have been the peak rise. In areas where the water table is deeper (i.e. 2.0m-2.5m) there was little water-level response to this precipitation event and water levels actually declined slightly (UW7,9, 13,14) in most of these areas. In general, in areas of high water table, water-level responses of 10 to 30 times the recorded amount of precipitation were observed, and in areas of low water table, water-level responses of less than four

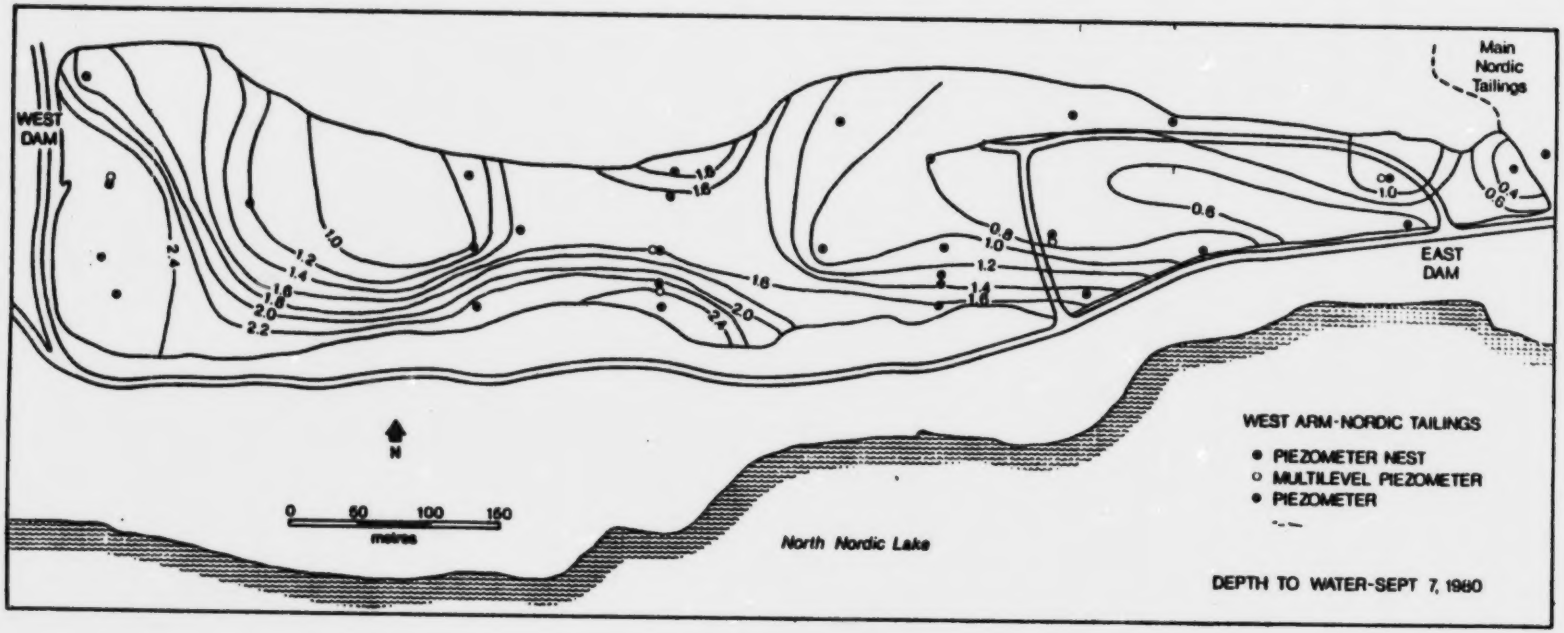

Figure 4 - Depth To The Water Table, September 7, 1980.

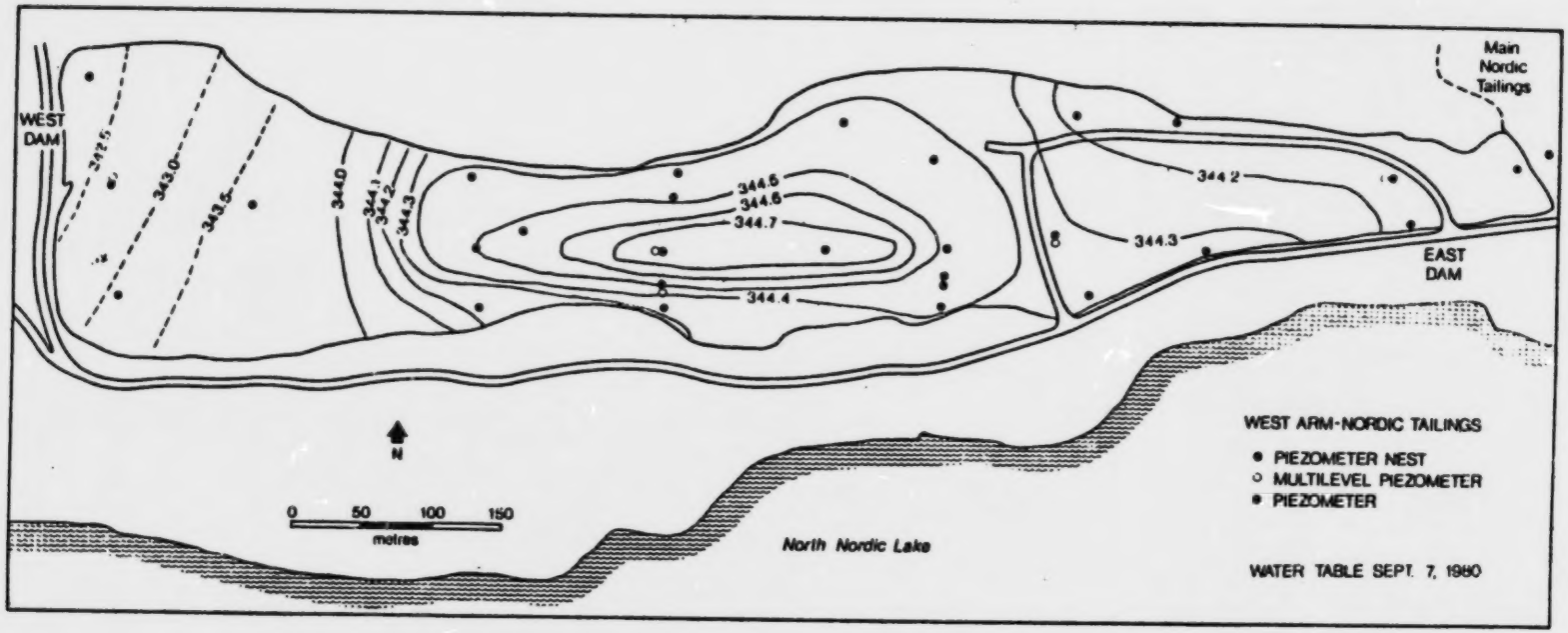

Figure 5 - Water Table Configuration, September 7, 1980.

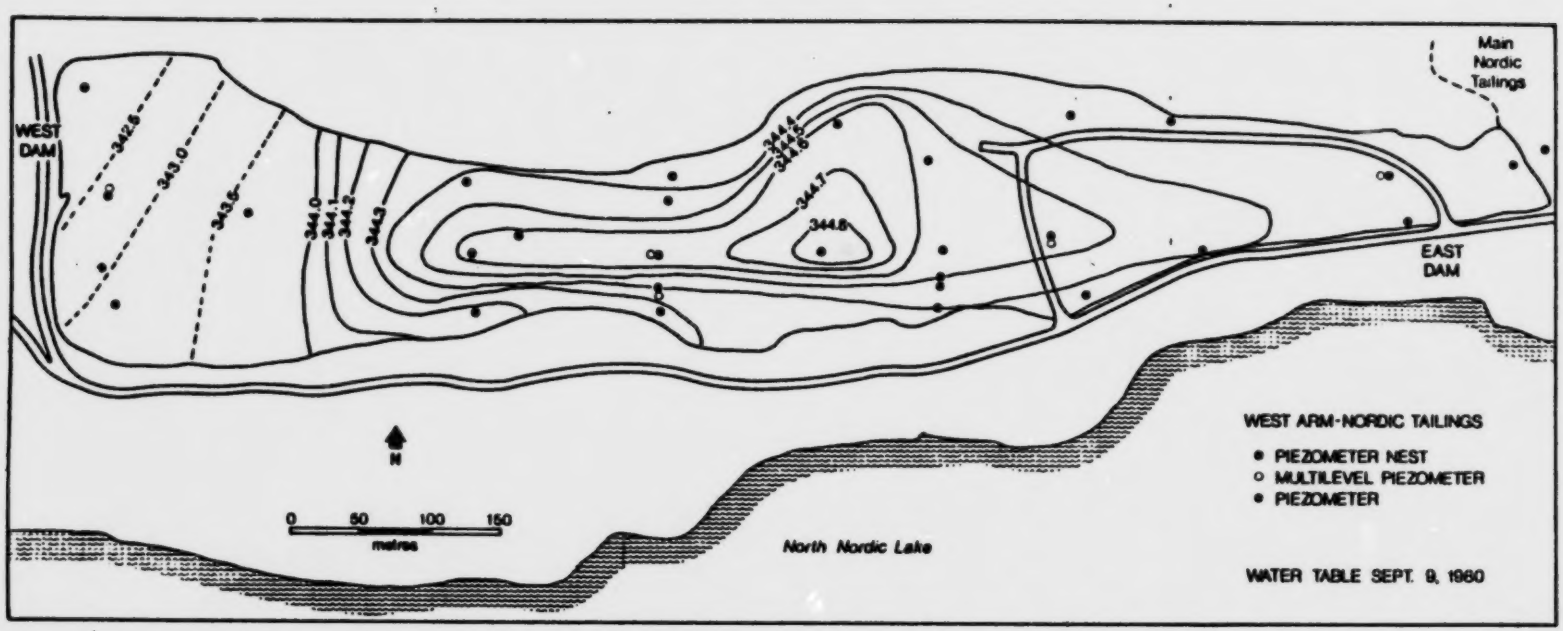

Figure 6 - Water Table Configuration, September 9, 1980.

times the amount of recorded precipitation was observed.

Although the general water-table configuration does not change significantly, the variable response of water levels to precipitation events results in rapid changes in hydraulic gradients within the flow system. Because this response in some areas is so rapid, the measured water levels may not be representative values at the time they were taken. As a result, water levels were measured as frequently as was feasible during the field investigation. Frequent measurements are necessary to determine the degree of water-level fluctuation and to determine a representative hydraulic-head distribution. Water levels are listed in Appendix B and precipitation data is listed in Appendix C.

3.1.2 Gradients

As shown by the water-table configuration in Figures 5 and 6, the horizontal gradient (i.e. water table slope) is much greater in the north-south direction in the eastern and central areas of the tailings and the horizontal gradient is greater in a westerly direction in the western segment of the tailings. This appears to be representative of the flow system, although the horizontal gradients may vary somewhat in areas where there is a significant response to recharge events.

Based on water-level data collected during the field-study period, representative horizontal gradients during times when no recharge was taking place appears to be as follows. The eastern portion of the tailings has the smallest horizontal gradient overall with a gradient on the order of 3.0×10^{-4}-4.0×10^{-4} in the east direction and 8×10^{-4}-2×10^{-3} in the north direction.

In the central portion of the tailings, where the water table is mounded and groundwater flows away from this central mound in all directions, the north-south component of flow is the most significant. The horizontal gradient away

from the water table mound is approximately $3x10^{-3}$ in the east direction, $1.5x10^{-3}$ in the west direction, $5.0x10^{-3}$ in the north direction and $1.0x10^{-2}$ in the south direction.

In the western portion of the tailings the horizontal gradient is in a westerly direction and is approximately $1.2x10^{-2}$ towards the west and as high as $6.6x10^{-3}$ in a north direction towards the west dam.

Figure 7 shows the configuration of water levels at a depth 340-341m elevation or approximately five metres below the tailings surface. A comparison with Figure 5 shows the horizontal gradient with depth in the tailings to be similar to those of the water table, except along the northern portion of the central groundwater mound. In this area the gradient is approximately 2.5 times greater ($1.2x10^{-2}$) than at the water table.

The magnitude of the horizontal gradient changes somewhat in parts of the tailings in response to recharge events. The size of the recharge event affects the magnitude of the change. As can be seen from the small recharge and between September 7, 1980 (Figure 5) and September 9, 1980 (Figure 6), the water table mound shifts eastward resulting in an increase in horizontal gradients around the new mound. Although the gradient increases are not substantial for this small recharge event, the water levels after a major recharge event (i.e. August 22, 1980) show a similar shift in the water table mound and a steepening of gradients away from this central mound with values three times that of the general horizontal gradients. The rest of the tailings area undergoes relatively little change as a result of recharge events.

Horizontal gradients in the sandy aquifer below the tailings (Figure 8) indicate flow from east to west with gradient increasing from approximately $1.2x10^{-3}$ in the east to $7.0x10^{-3}$ in the west. The water levels and horizontal

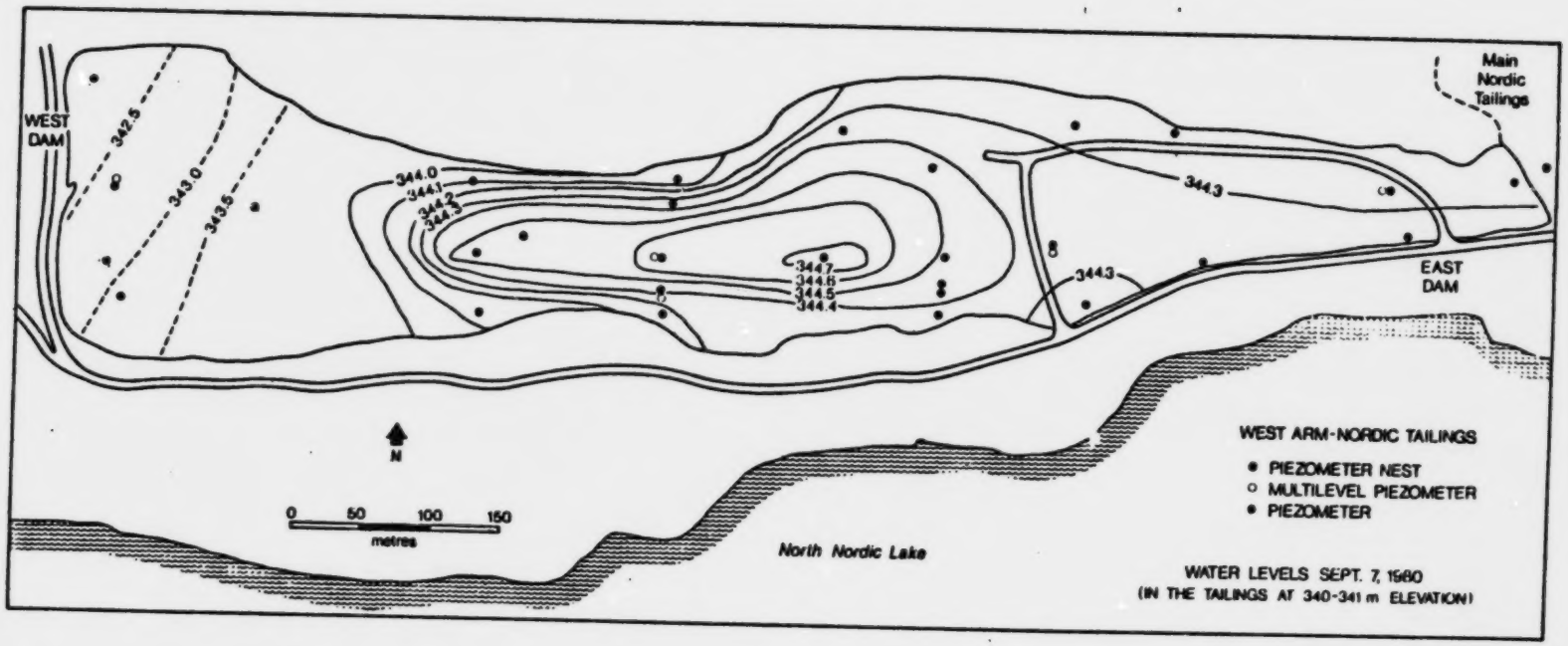

Figure 7 - Water Levels In The Tailings At 340-341m Elevation, September 7, 1980.

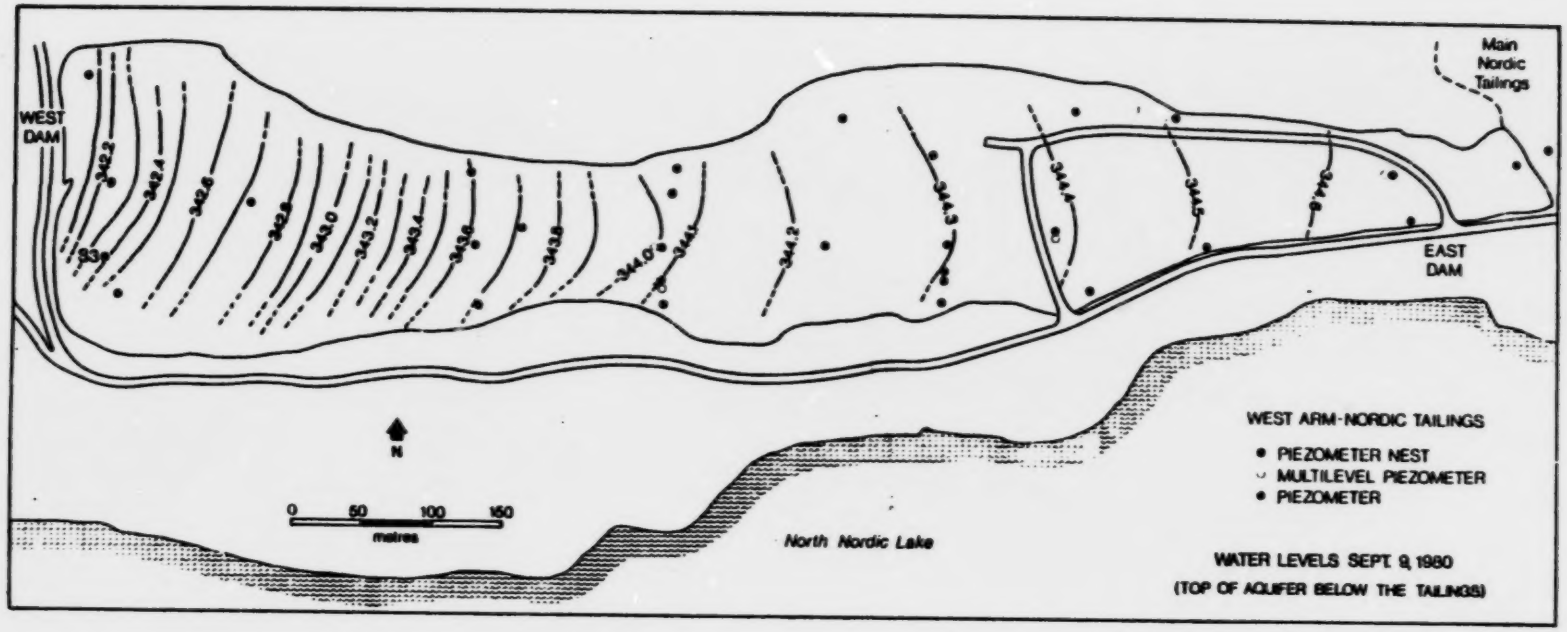

Figure 8 - Water Levels In The Top Of The Aquifer Below The Tailings, September 9, 1980.

gradient in the sandy aquifer appear to be relatively unaffected by recharge events. Some response is seen in the eastern portion of the site but does not appear to have a significant effect on the flow system.

Vertical downward gradients exist throughout most of the tailings area, except in parts of the eastern area of the tailings away from the east tailings dam. Variations in vertical gradients can be seen in the water level data shown in Appendix B. Figures B1-B5 show the water level distribution for cross sections B-B' to F-F' respectively during a period of no recharge. These gradients represent an average vertical gradient when no recharge is taking place, however the gradients can increase significantly in some areas of the tailings during recharge events.

In the eastern area (UW6) upward gradients exist in the tailings and across the underlying peat layer. The vertical gradient in this area of the tailings is approximately 4.0×10^{-2} and is approximately three times greater or 1.3×10^{-1} across the peat layer. An upward gradient of approximately 8×10^{-3} exists in the upper part of the aquifer below this segment of the tailings. This upward gradient decreases in a westerly direction towards UW5.

Elsewhere in the tailings a vertical downward gradient exists. A small downward gradient is found in the tailings above the peat layer. This gradient ranges from negligible to 2.6×10^{-2}. The drop in hydraulic head across the peat layer, which has a variable thickness, appears to increase in a westerly direction from as low as a few centimetres at UW5 to greater than a metre at UW8. It is not possible to determine accurately the gradient across the peat because the exact thickness of the peat is not known. If the peat varies in thickness from 0.3m to 1.0m, the gradient across the peat may be as low as 2×10^{-2} at UW5 and as high as 2 to 4 in the western end of the tailings.

Where the peat layer does not exist along the north and south portions of the tailings (see Figures A1-A5), a higher downward gradient generally exists in the tailings. The downward gradient is as small as 7.5×10^{-3} at UW14 and as high as 1×10^{-1} at UW16.

The portion of the aquifer below the tailings where downward gradients exist generally show only small changes in water levels at any particular site, with no trend in vertical gradients occuring.

Significant changes in vertical gradients occur in certain portions of the tailings in response to recharge events. In the eastern portion of the tailings, the vertical gradient reverses itself and flow is downward for a period of time after a significant recharge event. However, the upward gradient across the peat layer appears to be present even during major recharge events.

The most significant change in downward gradient occurs in the central portion of the tailings where the water-table mound shifts in response to recharge events as described in the previous section. Increases in the vertical gradient from negligible to 7.5×10^{-2} have been observed at a number of locations (i.e. UW3, UW11) in the vicinity of the water table mound. When the water table is deeper there appears to be little change in vertical gradient as a result of a recharge event.

Because of the short duration of the field study, it is not possible to determine how significant this fluctuation in gradient will be over a longer period of time.

3.2 Hydraulic Conductivity Distribution

Piezometer response tests for hydraulic conductivity were conducted at 51 piezometers in the tailings, in the peat and in the sand aquifer beneath

the West Arm tailings. The Hvorslev rising-head method was used for hydraulic conductivity tests as described in Section 2.2. The data was analyzed using the Hvorslev (1951) method of analysis as described by Freeze and Cherry (1979) using the equation:

$$T_o = \frac{\pi r^2}{F K}$$

where r is the radius of the piezometer, F is a factor that depends on the shape and dimensions of the piezometer intake, K is the hydraulic conductivity in the immediate vicinity of the piezometer, and T_o is the basic time lag, which is the time that would be required for the complete equalization of the head difference if the original rate of inflow into the piezometer were maintained.

To interpret the field recovery data the value of T_o is obtained from the relative water level versus time graph and the hydraulic conductivity is determined using the following equation:

$$K = \frac{r^2 \ln (L/r)}{2L T_o}$$

where r is the radius of the piezometer, and L is the length. $L/r > 8$ must be satisfied to use this equation. Using this equation and having L = 15cm and r = 1.6cm:

$$K = \frac{.19cm}{T_o}$$

Table 1 shows the results of the hydraulic conductivity tests. Most of the piezometers tested were along cross sections C-C', D-D' and F-F'. The values of hydraulic conductivity range from 1.27×10^{-3} cm/sec to 2.15×10^{-6} cm/sec in the tailings. Based on observations of the drill cuttings during piezometer installation, it was expected that the general trend would be increasing hydraulic conductivities from the northern to the southern portion of the tailings and an increased hydraulic conductivity in the western portion of the tailings. The

NEST	PIEZOMETER	DEPTH OF TIP (m)	LOCATION	DATE OF TEST (1980)	EQUILIBRIUM TIME (sec)	HYDRAULIC CONDUCTIVITY (cm/sec)
UW1	P1	5.2	tailings	Sept.11	1.83×10^{4}	1.04×10^{-5}
	P2	4.3	tailings	Sept.11	1.11×10^{4}	1.71×10^{-5}
	P3	3.4	tailings	Sept.11	9.9×10^{3}	1.92×10^{-5}
	P4	2.5	tailings	Sept.11	8.16×10^{3}	2.33×10^{-5}
	P5	1.5	tailings	Sept.11	2.76×10^{4}	6.88×10^{-6}
	P6	8.5	aquifer	Sept.11	4.5×10^{3}	4.22×10^{-5}
UW3	P1	5.5	tailings	Sept.11	4.86×10^{4}	3.91×10^{-6}
	P2	4.5	tailings	Sept.11	2.76×10^{4}	6.88×10^{-6}
	P3	3.5	tailings	Sept.11	3.24×10^{4}	5.86×10^{-6}
	P4	2.5	tailings	Sept.11	8.4×10^{3}	2.26×10^{-5}
	P6	10.7	aquifer	Sept.11	2.28×10	8.33×10^{-5}
UW6	P1	6.6	tailings	Oct. 7	8.82×10^{4}	2.15×10^{-6}
	P2	5.5	tailings	Oct. 7	4.14×10^{4}	4.59×10^{-6}
	P3	4.5	tailings	Oct. 7	8.64×10^{3}	2.2×10^{-5}
	P4	3.5	tailings	Oct. 7	9.0×10^{3}	2.11×10^{-5}
	P5	2.5	tailings	Oct. 7	7.92×10^{3}	2.4×10^{-5}
	P6	1.5	tailings	Oct. 7	7.2×10^{3}	2.6×10^{-5}
	P7	8.7	aquifer	Oct. 7	4.5×10^{3}	4.2×10^{-5}
UW7	P1	8.0	tailings	Oct. 7	2.79×10^{4}	6.8×10^{-6}
	P2	7.0	tailings	Oct. 7	3.6×10^{4}	5.28×10^{-6}
	P3	6.0	tailings	Oct. 7	1.02×10^{4}	1.86×10^{-5}
	P4	5.0	tailings	Oct. 7	3.42×10^{3}	5.5×10^{-5}
	P5	4.0	tailings	Oct. 7	2.1×10^{3}	9.0×10^{-5}
	P6	3.0	tailings	Oct. 7	1.05×10^{3}	1.8×10^{-4}
UW8	P2	8.0	peat	Aug.11-14	2.95×10^{5}	6.4×10^{-7}
UW9	P1	7.0	till	Oct. 7	9.6×10^{3}	1.98×10^{-5}
	P2	5.0	tailings	Oct. 7	1.44×10^{3}	1.32×10^{-4}
	P3	3.0	tailings	Oct. 7	5.7×10^{2}	3.33×10^{-4}
UW10	P5	10.4	peat	Aug.11-14	3.47×10^{5}	5.5×10^{-7}
UW11	P1	6.8	tailings	Oct. 3	6.3×10^{4}	3.0×10^{-6}
	P2	5.0	tailings	Oct. 3	2.94×10^{4}	6.5×10^{-6}
	P3	3.0	tailings	Oct. 3	1.62×10^{4}	1.17×10^{-5}
	P4	1.5	tailings	Oct. 3	1.62×10^{4}	1.17×10^{-5}
	P5	8.8	aquifer	Sept.8	1.2×10^{2}	1.58×10^{-3}
UW12	P1	4.3	tailings	Sept.10	1.68×10^{4}	1.13×10^{-5}
	P2	3.0	tailings	Sept.10	1.03×10^{4}	1.84×10^{-5}
	P3	2.0	tailings	Sept.10	2.04×10^{3}	9.3×10^{-5}
	P4	5.8	tailings	Sept.10	7.2×10^{3}	2.64×10^{-5}

Table 1 - Hydraulic Conductivity Values at Selected Piezometers.

Table 1 (cont'd)

NEST	PIEZOMETER	DEPTH OF TIP (m)	LOCATION	DATE OF TEST (1980)	EQUILIBRIUM TIME (sec)	HYDRAULIC CONDUCTIVITY (cm/sec)
UW14	P2	3.0	tailings	Sept.10	1.5×10^{3}	1.27×10^{-3}
	P4	7.8	tailings	Sept.10	8.1×10^{2}	2.35×10^{-4}
	P5	6.0	tailings	Sept.10	1.68×10^{3}	1.13×10^{-4}
UW16	P1	5.0	tailings	Sept.11	5.58×10^{4}	3.4×10^{-6}
	P2	4.0	tailings	Sept.11	2.31×10^{4}	8.23×10^{-6}
	P3	3.0	tailings	Sept.11	3.6×10^{3}	5.28×10^{-5}
	P4	2.0	tailings	Sept.11	1.8×10^{3}	1.06×10^{-4}
	P5	6.0		Sept.11	3.78×10^{4}	5.0×10^{-6}
UW21	P1	9.7	aquifer	Oct. 7	7.2×10^{2}	2.6×10^{-4}
	P3	6.5	tailings	Oct. 7	5.4×10^{4}	3.52×10^{-6}
	P4	5.5	tailings	Oct. 7	3.12×10^{4}	6.09×10^{-6}
	P5	3.5	tailings	Oct. 7	1.8×10^{3}	1.05×10^{-4}
UW23	P1	8.5	tailings	Sept.11	1.86×10^{4}	1.02×10^{-5}

piezometer test results indicate a general increase in hydraulic conductivity from north to south but not as large as expected (generally about an order of magnitude difference). The only area with a large difference is along cross section D-D' where there is almost three orders of magnitude difference in hydraulic conductivity from north to south. There is no significant increase in hydraulic conductivities in the western portion of the tailings, except at UW9 and in the shallow piezometers elsewhere.

In general, the hydraulic conductivities in the tailings decrease with depth by up to an order and a half of magnitude at most sites. This is in agreement with results shown by Blair et al (1980) for the Main Nordic tailings.

The average hydraulic conductivity within the tailings is about $2x10^{-5}$ cm/sec, which is in agreement with pumping tests conducted by Wardrop Associates Ltd. (1978) who obtained values of $1.0x10^{-5}$ cm/sec.

The hydraulic conductivity of the peat layer was measured in piezometers at two locations (UW8, UW10) in the western portion of the West Arm. Values obtained were $5.5x10^{-7}$ cm/sec and $6.5x10^{-7}$ cm/sec. These values are in good agreement with the value of $4x10^{-7}$ cm/sec obtained by Blair et al (1980) who calculated the hydraulic conductivity of the peat from the ground-water flux through the tailings above the peat layer at the Main Nordic tailings.

Hydraulic conductivities in the upper portion of the aquifer below the tailings ranged from $1.58x10^{-3}$ cm/sec to $4.2x10^{-5}$ cm/sec. These values are considerably lower than results obtained by Wardrop Associates Ltd. (1978) and Blair et al (1979) because the upper part of the aquifer in the West Arm Nordic tailings has a greater fraction of fine grained material than the lower part of the aquifer and the aquifer at the Main Nordic tailings.

3.3 Groundwater Flux And Velocity

Because of the spatial variability in hydraulic conductivity and spatial and time variability in the vertical hydraulic gradients, detailed calculations of groundwater flux and velocity throughout the West Arm tailings cannot be made at present. However, estimates can be made on the basis of the present data. Table 2 shows estimates of downward velocity and flux along cross sections C-C', D-D', and F-F'. The area of the West Arm west of UW5, where downward gradients begin, can be divided into two main sections, which are, the tailings underlain by the peat layer and the tailings where the peat layer is absent.

For calculation of velocity and flux across the peat layer, a hydraulic conductivity of 6×10^{-7} cm/sec was used (based on results given in the previous section). Hydraulic gradients were based on the assumption of the peat l[illegible] being 1.0 metre thick. The flux or specific discharge through the peat layer ranges from 0.025 m^3/m^2/year to 0.11 m^3/m^2/year. Based on the hydraulic head drop across the peat layer, the average specific discharge is in the order of 0.07 m^3/m^2/year. However, if the average thickness of the peat layer is as low as 0.5m, the specific discharge would be 0.14 m^3/m^2/year. Based on the extrapolation of the peat layer from drilling data as shown in Figures A1-A5 in Appendix A, the approximate area of the peat in which this discharge is occurring is 1.0×10^5 m^2. As a result the total discharge across the peat layer (based on the above estimates) could range from 7.0×10^3 m^3/year to 1.4×10^4 m^3/year. The average downward velocity through the peat is in the range of 0.25 m/yr to 0.5 m/yr, assuming a porosity of 0.3.

In areas where the peat is absent the specific discharge and velocity of the groundwater are considerably more variable because of the spatial

CROSS SECTION	NEST	HYDRAULIC CONDUCTIVITY cm/sec	DOWNWARD GRADIENT	SPECIFIC DISCHARGE $m^3/m^2/year$	DOWNWARD VELOCITY m/year
C-C'	UW1	$6x10^{-7}$	$2x10^{-1}$	.04	0.13
C-C'	UW11	$6x10^{-7}$	$1.3x10^{-1}$	.025	0.08
C-C'	UW12	$2.6x10^{-5}$	$2.5x10^{-2}$	.21	0.70
D-D'	UW3	$6x10^{-7}$	$6x10^{-1}$	.11	0.37
D-D'	UW16	$5x10^{-6}$	$1.6x10^{-1}$	.25	0.83
D-D'	UW14	$2.4x10^{-4}$	$1.3x10^{-2}$	.95	3.17
F-F'	UW7	$6x10^{-7}$	$4.0x10^{-1}$	.08	0.27
F-F'	UW21	$6x10^{-7}$	$2.5x10^{-1}$	.05	0.17
F-F'	UW9	$2x10^{-5}$	$1.2x10^{-1}$	.75	2.5

Table 2 - Estimates Of Groundwater Flux and Velocities.

variability in hydraulic conductivity and downward gradients specific discharge out of the tailings where the peat layer is absent ranges from 0.21 m^3/m^2/year to 0.95 m^3/m^2/year. Based on hydraulic conductivity distributions and average specific discharge out of the tailings in areas where the underlying peat layer is absent is 0.7 m^3/m^2/year. The approximate area where the peat is absent is 1.5×10^4 m^2. Therefore, the total discharge in a downward direction out of the tailings is 1.05×10^4 m^3/yr.

The downward velocity where the peat layer is absent ranges from 0.7 m/yr to 3.17 m/yr and averages 2.3 m/yr.

Based on the above calculations the total downward flux out of the tailings ranges from 1.75×10^4 m^3/yr to 2.45×10^4 m^3/yr. This range could be even greater depending on the actual area of the tailings in which the underlying peat is absent. Using present calculations, 13% of the area with downward gradients has the peat layer absent and from 43% to 60% of the downward flux occurs over this small area. As a result, small changes in the magnitude of this area could significantly change the amount of flux out of the tailings.

Another factor contributing to the flux out of the tailings may be the horizontal component of flow especially at the west dam and areas north and south of the central water table mound where horizontal gradients are much greater than elsewhere in the tailings.

3.4 Electrical Conductance and pH Measurements

The trends in the pH and electrical conductance values, even though they are preliminary data, are consistent with the groundwater flow conditions described in the previous sections. In areas where upward gradients exist, pH is near neutral (6.0-7.5) throughout the entire thickness of the tailings,

including the water table zone. In zones of upward gradient, the tailings have a low groundwater velocity, and are generally being recharged by water from the lower aquifer. The values of electrical conductances in these areas are generally of the order of 3000µS. Appendix D presents the field measurements of pH and electric conductance. Appendix D also shows pH, electrical conductance and depth to the water level versus depth below the surface of the tailings. Figures D8 through D17 show pH and electrical conductances along cross sections B-B'-F-F'. Figure D2 shows results for areas in which upward gradients exist in the tailings.

In areas of downward gradients with small velocities such as UW10 and UW11 (Figure D4), the pH is also near neutral (6.0-7.5) and the electrical conductances are as high as 8 000µS in the water-table zone with values lower in the tailings of the order of 4 000µS.

In areas with high downward groundwater velocity, such as at UW14 (Figure D5) and UW9 (Figure D3) the pH ranges from as low as 1.4 at the water table to 5.5 at the base of the tailings. It should be noted that the site with the highest downward velocity (UW14) has a pH of about 1.5 all the way to the bottom of the tailings. Electrical conductances range from 25 000µS (UW14) at the water table to 6 500µS (UW9) with depth. Again, UW14 with the highest velocity, has electrical conductances as high as 15 000µS at the base of the tailings.

In some areas where horizontal flow within the tailings may be the direction of dominant groundwater velocities such as at UW7 (Figure D3) pH and electrical conductance are generally elevated only in the water table zone.

Measurements of pH and electrical conductance of water from piezometers and multilevel bundles in the sandy aquifer below the tailings are variable and

indicate the presence of tailings water in a portion of the aquifer. pH generally ranged from 5.5 to 7.0 with some values as low as 4.7. Electrical conductance generally ranged from 500-2 500µS with some values as high as 3 500µS.

The area of the most elevated values of electrical conductance was at UW23 (Figure D7), which is adjacent to the area of the highest velocities and electrical conductances in the tailings (UW14). Figure D15 shows the difference in electrical conductance between a section of the aquifer near the edge of the peat layer (UW23) and a section of the aquifer under the centre portion of the peat layer (UW3). Because of the high downward velocities at the southern edge of the tailings, it appears that water moves out of the tailings and around the peat layer into the sandy aquifer. Other areas such as UW24 (Figures D7, D11) show a lower pH in the aquifer than in the overlying tailings indicating contaminated tailings water moving significant distances through the aquifer and/or bedrock flow system. It is not known what the degree of contaminantion is as a result of movement of tailings water out of the tailings.

4.0 DISCUSSION

4.1 Groundwater Flow System

The configuration of the water table and the hydraulic-head distribution in the West Arm Nordic tailings is controlled mainly by the geologic setting surrounding the tailings. To a lesser extent the way in which the tailings were deposited in the West Arm controls the water table configuration and hydraulic-head distribution.

A water-table mound exists in the central area of the tailings for two reasons. Firstly, the peat layer underlying much of the tailings appears to be present everywhere but along the north-south edges of the tailings. The quantity of water moving from the tailings through the underlying peat layer is less than the quantity of water that recharges the water table by infiltration and, as a result a mound forms. This accumulation of water increases the water table slope and water moves away from the mound. The result is water flow around the north and south edges of the peat layer, either into the underlying aquifer or into the bedrock. This is evidenced by the higher groundwater velocities occurring where the peat is absent. Secondly, the water table mound occurs only in the central portion of the tailings, not at either end where the peat layer is also present, because of the influence of the tailings dam and surface drainage. In the western portion of the tailings there is a relatively high horizontal gradient in a westerly direction towards the west dam. This is a result of a significant amount of seepage through the west dam. In the eastern portion of the tailings where a high water table exists, a shallow drainage ditch is located along the east-west road on the tailings and drains through the east dam. As a result the horizontal gradient is small and the general flow direction is towards the drainage ditch.

The depth to the water table and the variation in water-table response is the result of the way in which the tailings were deposited. The tailings were laid down in the West Arm from a pipeline running along the southern edge of the present tailings area. As a result, finer grained material is located in the north and coarser grained tailings material is located in the southern and western area of the tailings. Although the hydraulic conductivity contrast between the north and south areas of the tailings was not as great as expected, in most cases drill cuttings indicated that the southern areas had a significantly higher coarse-grained fraction than the north. As a result the capillary zone is greater in the northern and eastern areas of the tailings and the water table is nearer ground surface. This causes a faster and more significant response to recharge events than elsewhere or the tailings and hence the shift in the water table mound to the northeast after a recharge event.

Although velocity and flux calculations out of the tailings were presented in an earlier section it is important to emphasize here that considerable error could arise in determining these parameters regardless of the data base. As stated previously, a major portion of the downward flux out of the tailings occurs over a small portion of the tailings where the peat is absent. Because there is considerable variability in the bedrock elevation and some variation in the elevation of the peat layer it will be very difficult to determine the area of the tailings where the peat is absent and only a small difference in the estimate of this area will have a significant effect on the estimate of the flux out of the tailings. The thickness of the peat layer will also affect the flux out of the tailings. The horizontal flux out of the tailings may also be a significant component of the flux out of the tailings.

If the calculation of a water mass balance is to be achieved on the

West Arm Nordic tailings various sources of groundwater flux in and out of the tailings must be considered. Fluxes out of the tailings occur through the following pathways: 1) downward through the peat layer into the aquifer; 2) downward from the tailings directly into the aquifer; 3) downward and/or horizontally into the bedrock; 4), horizontally through the tailings dams; and 5), surface runoff across the tailings dams. Fluxes into the tailings occur through the following pathways: 1) upward flow through the peat in the eastern portion of the tailings; 2), discharge from the bedrock or surface runoff along the edge of the tailings; 3), discharge through the Main Nordic tailings into the West Arm; and 4), recharge by precipitation directly on the tailings. Any of the above fluxes would be difficult to determine to within a factor of two or three which would make an evaluation of a water mass balance on the West Arm Nordic tailings extremely difficult. The best that can be expected in future studies would be obtained from investigations of small distinct segments of the West Arm tailings.

4.2 pH and Electrical Conductance

Preliminary pH and electrical conductance measurements conducted on the water in the West Arm Nordic tailings and the aquifer below indicate a highly variable chemical composition over the area. This variability appears to be controlled to a great extent by the groundwater flow system at the site.

Within the tailings, areas with downward flow and high groundwater velocities have the highest degree of acidification in the porewater, extending in some cases to the base of the tailings. Areas with downward flow and relatively low groundwater velocities usually occur in areas of low hydraulic conductivities and generally have decreasing rates of acidification with depth.

With this decrease a decrease in electrical conductance also occurs. In areas where upward flow generally occurs, the porewater is still relatively neutral and electrical conductance is relatively consistent throughout the tailings. On the basis of preliminary water chemistry it appears that various rates of acidification are present throughout the tailings and appears to be influenced by such parameters as groundwater flow velocity, and grain size distribution.

Preliminary pH and electrical conductances in the aquifer below the tailings indicate some degree of contaminantion from tailings water. The portion of the aquifer near the edge of the peat layer contains tailings water which has flowed around the peat layer into the aquifer. It is expected that a portion of this water also flows into the fractured bedrock. In some areas of the aquifer away from the edge of the peat, pH's lower than pH's in the tailings above that area of the aquifer are found, indicating a significant movement of contaminanted water within the aquifer. In the portion of the aquifer below the eastern segment of the tailings, where upward flow occurs, elevated levels of electrical conductance were measured indicating contamination from tailings water from the Main Nordic tailings. Because much of the contamination of the aquifer by tailings water occurs along the edge of the aquifer and at the tailings-bedrock-aquifer interface, the degree of contaminantion of aquifer and bedrock water is not known.

5. CONCLUSIONS

The West Arm tailings deposit has areas of upward groundwater flow, areas of downward flow, and zones within the tailings in which the flow is mainly horizontal. The peat layer at the bottom of the tailings is present in only part of the area. The bedrock surface beneath the tailings is very irregular and has large variations in elevation over short distances. In some areas seepage from the tailings enters the sand aquifer beneath the tailings or beneath the peat and in other areas the seepage enters the bedrock, which appears to be quite permeable.

The chemical composition of pore water in the tailings, as represented by pH and electrical conductances is also highly variable. At some sites the water has near neutral pH, whereas at other sites much of the pore water is moderately or strongly acidic. At one site in coarse-grained tailings with downward flow, the pH of the porewater was about 1.5 from the water table to the bottom of the tailings and, as such, represents the most extreme case of acid development that has been observed within tailings in the Elliot Lake area.

Although the general trends in hydraulic head and hydraulic gradient in the West Arm tailings have been delineated in an appreciable degree of detail, it is not feasible with the present data to accurately delineate groundwater flow paths within and beneath the tailings. Accurate delineation of the groundwater flow paths is problematic because of complex stratification in the tailings, the discontinuous nature of the peat layer, and the heterogeneous nature of the aquifer beneath the tailings. Because of the problematic nature of the groundwater flow paths, the West Arm tailings is not well suited for studies of radionuclide mass balance. Relative to the West Arm tailings,

the Nordic Main tailings area is probably better suited for studies of subsurface contaminant mass balance because of the existence of extensive areas in which the direction of the hydraulic gradient is invariable where the peat layer is continuous and where the effects of surface leaching and runoff are apparently less influential. However, the spatial variability of groundwater flow and of water chemistry in the West Arm tailings are very favorable for investigations of the factors that influence the rate and extent of development of acidic pore water in the tailings and the acid-related mobilization of radionuclides in the pore water.

Appendix A

Description of Groundwater Monitoring Installations

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP (m)	ELEVATION OF TOP OF TIP (m)	ELEVATION TO GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW1	P1	Cobra	Aug. 6	5.2	340.40		346.48[1]	--wet at 0.6 m	--slow drilling at 2.0 m
	P2	Cobra	Aug. 6	4.3	341.30		346.46[9]	--tailings coarse to fine-grained	
	P3	Cobra	Aug. 6	3.4	342.20		346.51[5]	--peat at 7.8-8.2 m	
	P4	Cobra	Aug. 6	2.5	343.10		346.55[5]		
	P5	Cobra	Aug. 6	1.5	344.10	345.60	346.50[9]		
	P6	auger & plug	Aug. 10	8.5	337.10		346.55[5]		
UW2	P1	Cobra	Aug. 6	5.6	340.10		346.75[0]	--wet at 0.6 m	--slow at 5.2 m
	P2	Cobra	Aug. 7	4.5	341.20		346.77[4]	--tailings fine-grained	
	P3	Cobra	Aug. 7	3.5	342.20		346.77[7]	--peat at 7.9-8.8 m	
	P4	Cobra	Aug. 7	2.5	343.20		346.79[2]		
	P5	Cobra	Aug. 7	1.5	344.20	345.70	346.85[0]		
	P6	auger & plug	Sept. 2	9.1	336.60		346.81[8]		
UW3	P1	Cobra	Aug. 7	5.5	340.80		347.27[7]	--wet at 1.3 m	--slow at 5.5-5.5 m
	P2	Cobra	Aug. 7	4.5	341.80		347.32[0]	--tailings fine-grained	
	P3	Cobra	Aug. 7	3.5	342.80		347.29[5]	--peat at 8.5-9.7 m	
	P4	Cobra	Aug. 7	2.5	343.80		347.21[9]	--compact sandy silt at 9.7-10.7 m	
	P5	Cobra	Aug. 7	1.5	344.80	346.30	347.26[5]		--refusal at 1.5 m
	P6	auger & plug	Aug. 10	10.7	335.60		347.29[2]		
UW4	P1	Cobra	Aug. 7	3.3	342.70	346.00	347.05[1]	--wet at 1.7 m	--refusal at 3.3 m
UW5	P1	Cobra	Aug. 7	6.6	338.40		346.11[9]	--wet at 0.5 m	
	P2	Cobra	Aug. 7	5.5	339.50		346.13[1]	--tailings fine-grained	
	P3	Cobra	Aug. 7	4.5	340.50		346.13[1]	--peat at 7.8-8.5 m	
	P4	Cobra	Aug. 7	3.5	341.50		346.07[3]	--coarse sand below peat for 1.5 m	
	P5	Cobra	Aug. 7	2.5	342.50		346.10[3]		
	P6	Cobra	Aug. 7	1.5	343.50	345.00	346.14[0]		
	P7	auger & plug		8.8	335.20		346.09[1]		
UW6	P1	Cobra	Aug. 8	6.6	338.70		346.36[3]	--wet at 0.6 m	
	P2	Cobra	Aug. 8	5.5	339.80		346.40[5]	--tailings fine-grained	
	P3	Cobra	Aug. 8	4.5	340.80		346.43[0]	--peat at 7.6-8.5 m	
	P4	Cobra	Aug. 8	3.5	341.80		346.39[6]		

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP (m)	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW6	P5	Cobra	Aug. 8	2.5	342.80	345.30	346.38[1]	--coarse sand below the peat	
	P6	Cobra	Aug. 8	1.5	343.80		346.32[6]		
	P7	auger & plug	Aug. 8	8.7	336.60		346.46[6]		
UW7	P1	auger	Aug. 9	8.0	337.00		346.86[9]	--wet at 2.6 m	--drill at 30'- no plug problem with installation of P1
	P2	auger	Aug. 9	7.0	338.00		345.86[6]	--tailings coarse grained	
	P3	auger	Aug. 9	6.0	339.00		346.84[7]	--peat at 8.0-8.8 m	
	P4	auger	Aug. 9	5.0	340.00		345.82[9]		
	P5	auger	Aug. 9	4.0	341.00		345.79[3]		
	P6	auger	Aug. 9	3.0	342.00	345.00	345.81[7]		
UW8	P1	auger & plug	Aug. 9	9.1	335.90		346.27[4]	--wet at 1.5 m	--plug used in auger
	P2	auger	Aug. 9	8.0	337.00		346.30[5]	--tailings fine-grained	
	P3	auger	Aug. 9	7.0	338.00		346.28[0]	--peat at 8.0-9.0 m	
	P4	auger	Aug. 9	6.0	339.00		346.26[8]		
	P5	auger	Aug. 9	5.0	340.00		346.28[6]		
	P6	auger	Aug. 9	4.0	341.00		346.32[9]		
	P7	auger	Aug. 9	3.0	342.00	345.00	346.36[0]		
UW9	P1	auger & plug	Aug. 9	7.0	338.00		346.65[3]	--wet at 2.4 m	--refusal could be bedrock or bouldery till
	P2	auger	Aug. 9	5.0	340.00		346.62[9]	--tailings coarse	
	P3	auger	Aug. 9	3.0	342.00	345.50	346.63[5]	--refusal at 7.3 m - rock	
UW10	P1	auger & plug	Aug. 9	9.0	336.50		346.38[1]	--wet at 1.8 m	--drill to 9.1 m - no peat
	P2	auger	Aug. 9	7.0	338.50		346.37[8]	--tailings fine-grained	
	P3	auger	Aug. 9	5.0	340.50		346.39[0]	--peat at 8.5-10.4 m	
	P4	auger	Aug. 9	3.0	342.50		346.36[6]		--redrill to below peat
	P5	auger	Aug. 10	10.4	335.10	345.50	346.36[0]		
UW11	P1	Cobra	Aug. 12	6.8	338.40		346.15[1]	--wet at 0.4 m	
	P2	Cobra	Aug. 12	5.0	340.20		346.20[7]	--tailings fine-grained	
	P3	Cobra	Aug. 12	3.0	342.20		346.17[1]	--peat at 8.1-8.5 m	
	P4	Cobra	Aug. 12	1.5	343.70	345.20	346.20[1]		
	P5	auger & plug	Sept. 6	8.8	336.40		346.19[1]		

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP (m)	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW12	P1	Cobra	Aug. 13	4.3	341.70		346.92[4]	--wet at 1.2 m	
	P2	Cobra	Aug. 13	3.0	343.00		346.95[4]	--tailings coarse-	
	P3	Cobra	Aug. 13	2.0	344.00	346.00	346.94[4]	grained to 3.6 m	
	P4	auger & plug	Sept. 2	5.8	340.20		346.89[6]	and medium to 5.8 m	
								- rock at 5.8 m	
UW13	P1	Cobra	Aug. 13	3.4	343.10		347.52[6]	--wet at 1.5 m	--refusal at 3.4 m
	P2	Cobra	Aug. 13	3.0	343.50	346.50	347.54[6]	--tailings coarse-	--refusal 3.0 m
	P3	auger & plug	Sept. 1	7.0	339.50		347.52[1]	grained	
	P4	auger	Sept. 1	5.5	341.00		347.52[1]	--rock at 7.0 m	
UW14	P1	Cobra	Aug. 13	4.3	342.50		347.88[9]	--wet at 1.5 m	--refusal at 4.3
	P2	Cobra	Aug. 13	3.0	343.80		347.86[4]	--tailings coarse-	--slow drilling
	P3	Cobra	Aug. 13	2.0	344.80	346.80	347.87[5]	grained	--slow drilling
	P4	auger & plug	Sept. 1	7.8	339.00		347.77[2]	--rock at 7.9 m	
	P5	auger	Sept. 1	6.0	340.80		347.75[0]		
UW15	P1	Cobra	Aug. 14	6.7	338.80		346.37[5]	--wet at 0.1 m	
	P2	Cobra	Aug. 14	5.0	340.50		346.39[6]		
	P3	Cobra	Aug. 14	3.0	342.50		346.35[0]		
	P4	Cobra	Aug. 14	1.5	344.10	345.50	346.41[7]		
	P5	Cobra	Aug. 14	3.35	342.15		346.62[7]		--at the base of main tailing
	P6	Cobra	Aug. 14	3.5	342.00		346.60[5]		--at the base of main tailing
UW16	P1	Cobra	Aug. 15	5.9	341.20		347.22[2]	--wet at 1.0 m	--slow drilling at 4.3 m
	P2	Cobra	Aug. 15	4.0	342.20		347.22[7]	--tailings fine-	--slow at 1.1 m
	P3	Cobra	Aug. 15	3.0	343.20		347.22[4]	grained	--slow at 1.1 m
	P4	Cobra	Aug. 15	2.0	344.20	346.20	347.19[6]	--rock at 6.4 m	
	P5	auger & plug	Sept. 1	6.1	340.10		347.10[3]		
UW17	P1	Cobra	Aug. 19	4.0	341.60		346.62[5]	--wet at 0.8 m	--slow drilling at 3.6 m
	P2	Cobra	Aug. 19	1.5	344.10	345.60	346.60[9]	--tailings fine-	
	P3							grained	
	P3	auger & plug	Sept. 2	7.1	338.50		347.57[8]	--rock at 7.0 m	

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP (m)	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW18	P1	Cobra	Aug. 19	5.0	340.10		346.12	--wet at 0.1 m	
	P2	Cobra	Aug. 19	1.5	343.60	345.10	346.11	--tailings fine-grained	
UW19	P1	Cobra	Aug. 19	3.0	342.90		346.74	--wet at 1.3 m	--slow drilling
	P2	Cobra	Aug. 19	2.0	343.90		346.78	--tailings coarse-grained	--slow drilling
	P3	Cobra	Aug. 19	1.4	344.50	345.90	346.75		
	P4	auger & plug	Sept. 2	4.3	341.60		346.69	--bouldery from 3.6 -4.6 m	
UW20	P1	Cobra	Aug. 19	5.9	339.40		346.28	--wet at 1.5 m	--rock at 6.0 m
	P2	Cobra	Aug. 19	2.7	342.60		346.29	--tailings coarse-grained	--rock at 2.8 m
	P3	Cobra	Aug. 19	1.5	343.80	345.30	346.24		
UW21	P1	auger & plug	Sept. 1	9.7	334.60		345.45	--wet at 2.2 m	
	P2	auger	Sept. 1	7.1	337.20		345.49	--tailings medium-grained	
	P3	auger	Sept. 1	6.5	337.80		345.52		
	P4	auger	Sept. 1	5.5	338.80		345.54	--peat at 7.1-7.5	
	P5	auger	Sept. 1	3.5	340.80	344.30	345.48	--silty sand below peat	
UW22	P1	auger & plug	Sept. 6	18.0				--tailings coarse-grained	--gravelly at 16.7 m - refusal
	P2	auger & plug	Sept. 6	16.5					
	P3	auger	Sept. 6	5.5				--peat at 16.7-17.3 m	
UW23	P1	auger	Sept. 6	8.5	338.00	346.50	347.32	--peat at 9.1-9.7 m	
UW24	P1	auger & plug	Sept. 7	8.2	337.30		346.45		
	P2	auger	Sept. 7	7.5	338.00		346.51	--peat at 7.6 m	
	P3	auger	Sept. 7	1.5	344.00	345.50	346.47	--rock at 8.4 m	
UW25	P1	Cobra	Sept. 10	5.9				--tailings coarse-grained	
	P2	Cobra	Sept. 10	1.5					
UW26	P1	Cobra	Sept. 10	5.8				--tailings fine-grained	
	P2	Cobra	Sept. 10	1.5					

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP (m)	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW	S1	auger & plug	Sept. 7	10.3	335.90	346.20	347.32[3]	--peat at 8.2-9.3 m	--rock at 10.3 m
UW	S2	auger & plug	Sept. 6	8.2	337.80	346.00	346.84[2]	--peat at 7.6-7.9 m	
	S2'	auger & plug	Sept. 6	7.2	338.80	346.00	346.80[1]	--rock at 7.3 m	
UW	S3	auger & plug	Sept. 7	9.9	335.20	345.10	346.29	--peat 8.1-9.0 m	

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW3 (bundle)	C.S.	auger	Sept. 2	19.4	326.90	346.30	347.21[8]	--hard 18.3 m	--drilled to 20 m
	1			18.4	327.90				--no water used
	2			17.4	328.90				
	3			16.4	329.90				
	4			15.4	330.90				
	5			14.4	331.90				
	6			13.4	332.90				
	7			12.4	333.90				
	8			11.4	334.90				
UW5 (bundle)	C.S.	auger	Sept. 3	15.2	330.00	345.20	346.10[3]	--gravelly at 14.7 m	--drilled to 15.3 m
	1			14.2	331.00				--water used
	2			13.2	332.00				
	3			12.2	333.00				
	4			11.2	334.00				
	5			10.2	335.00				
	6			9.2	336.00				
UW6 (bundle)	C.S.	auger	Sept. 3	13.7	331.80	345.50	346.46[3]	--bouldery at 13.7 m	--drilled to 13.7 m
	1			12.7	332.80			--coarse sand in the bottom of the augers	
	2			11.7	333.80				
	3			10.7	334.80				
	4			9.7	335.80				
	5			8.7	336.80				
	6			7.7	337.80				
UW7 (bundle)	C.S.	auger	Sept. 2	15.2	329.80	345.00	345.75[5]	--boulders or rock at 16.8 m	--drilled to 16.8 m
	1			14.2	330.80				--water used
	2			13.2	331.80				
	3			12.2	332.80				
	4			11.2	333.80				
	5			10.2	334.80				
	6			9.2	335.80				

NEST	PIEZOMETER	METHOD OF INSTALLATION	DATE (1980)	DEPTH TO TOP OF TIP	ELEVATION OF TOP OF TIP (m)	ELEVATION OF GROUND SURFACE (m)	ELEVATION OF TOP OF PIPE (m)	DESCRIPTION OF MATERIAL	COMMENTS
UW23 (bundle)	C.S.	auger	Sept. 7	13.7	332.80	346.50	347.48[3]	--hard at 13.7 m	--drilled to 13.7 m --water used
	1			12.7	333.80				
	2			11.7	334.80				
	3			10.7	335.80				
	4			9.7	336.80				

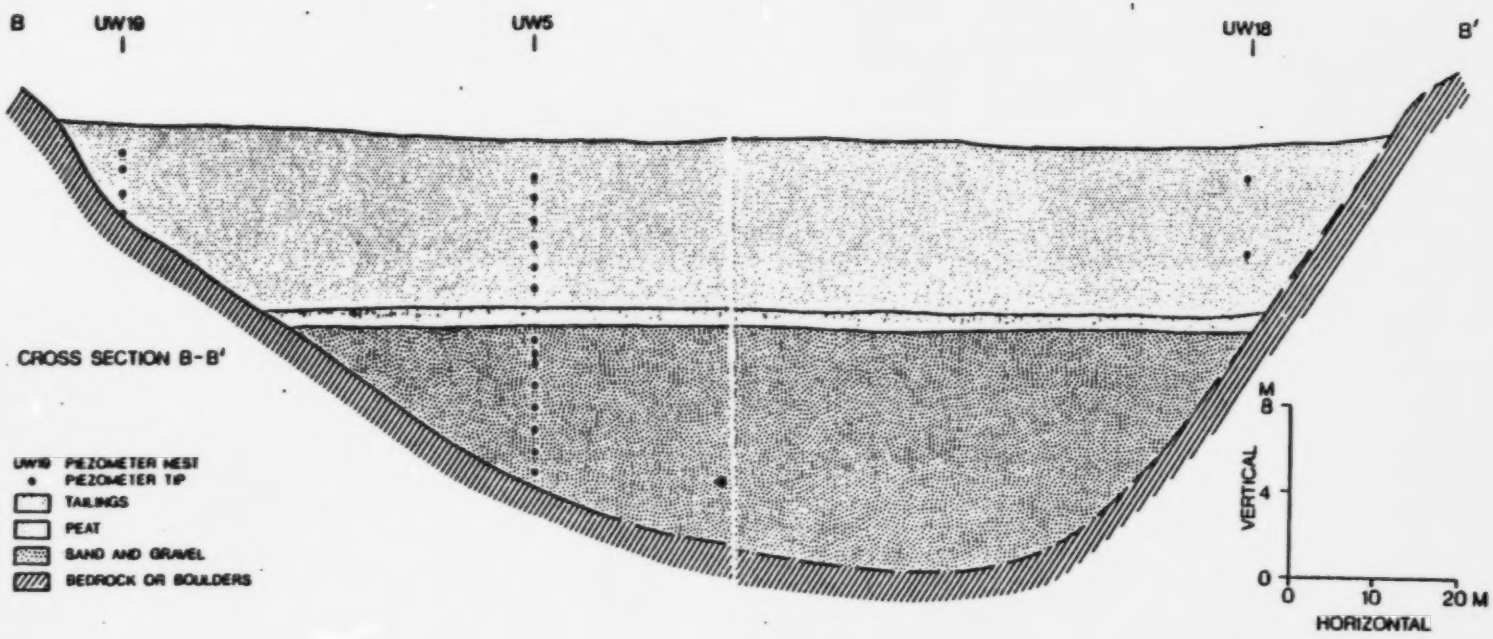

Figure A1 - Stratigraphy And Piezometer Locations Cross Section B-B'.

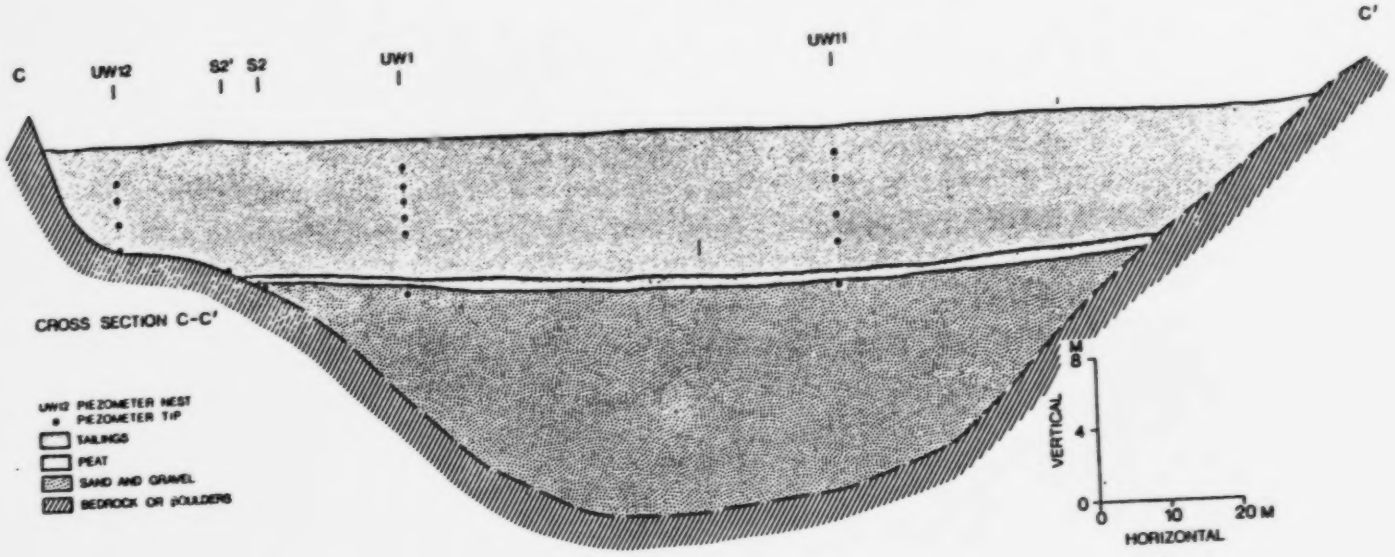

Figure A2 - Stratigraphy And Piezometer Locations Cross Section C-C'.

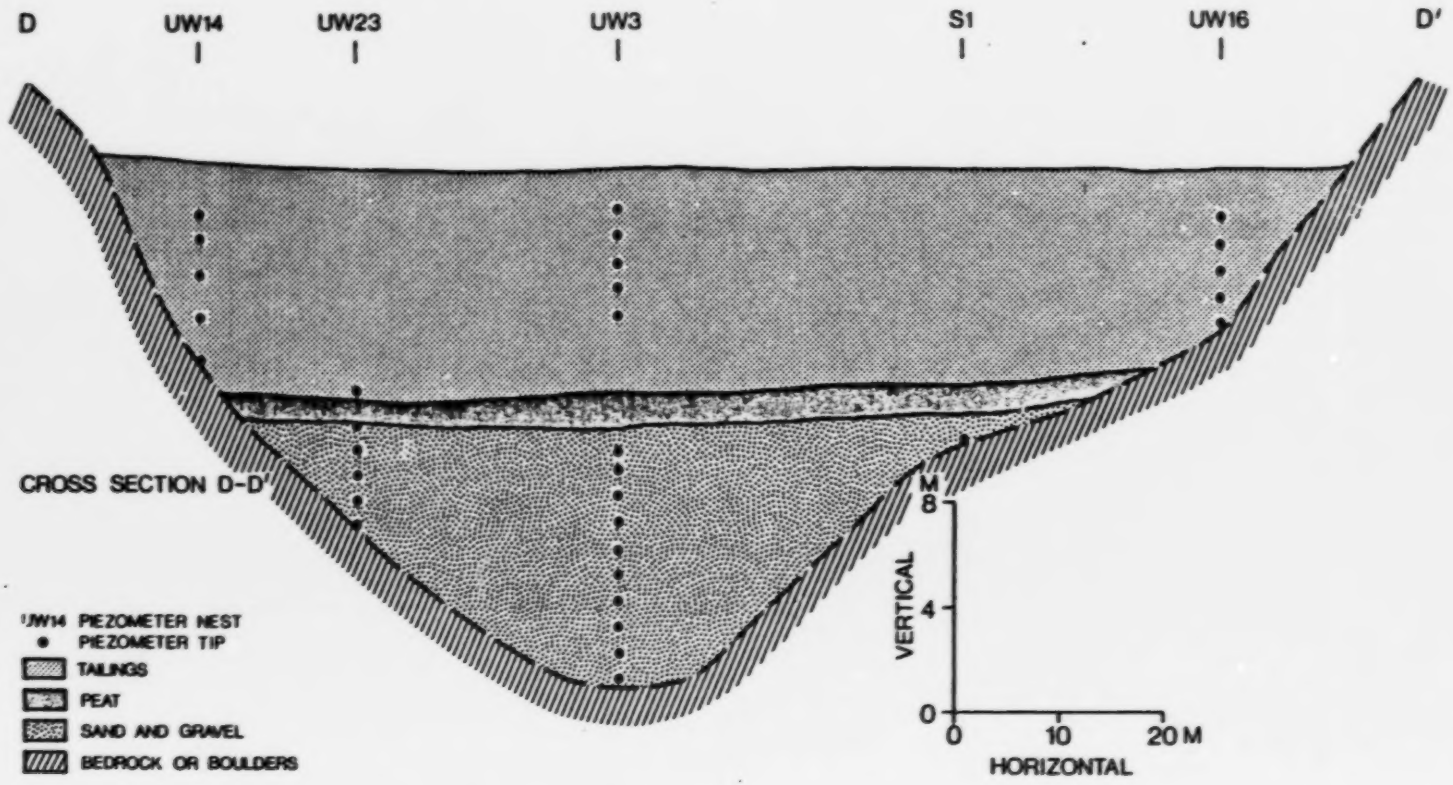

Figure A3 - Stratigraphy And Piezometer Locations Cross Section D-D'.

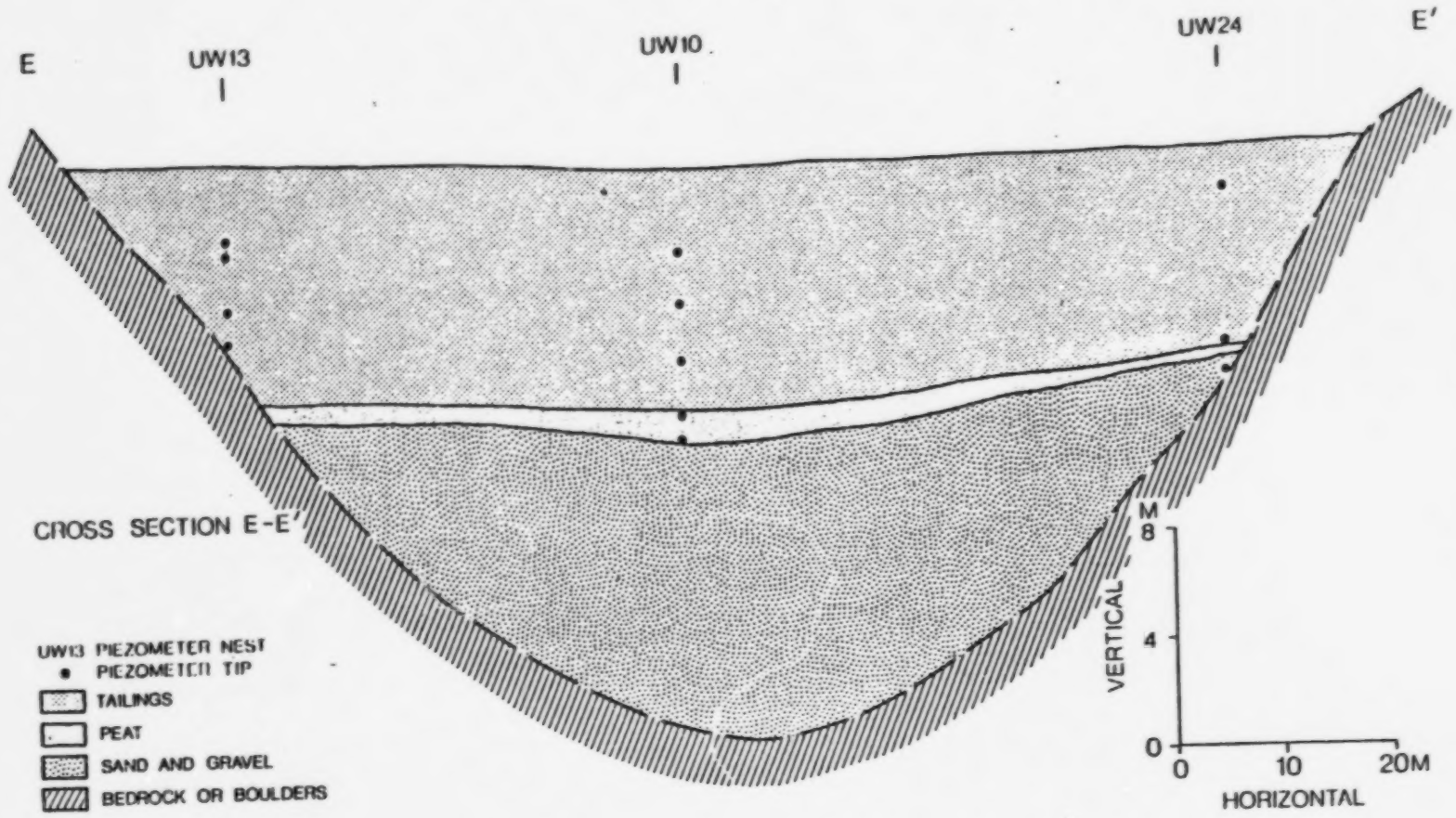

Figure A4 - Stratigraphy And Piezometer Locations Cross Section E-E'.

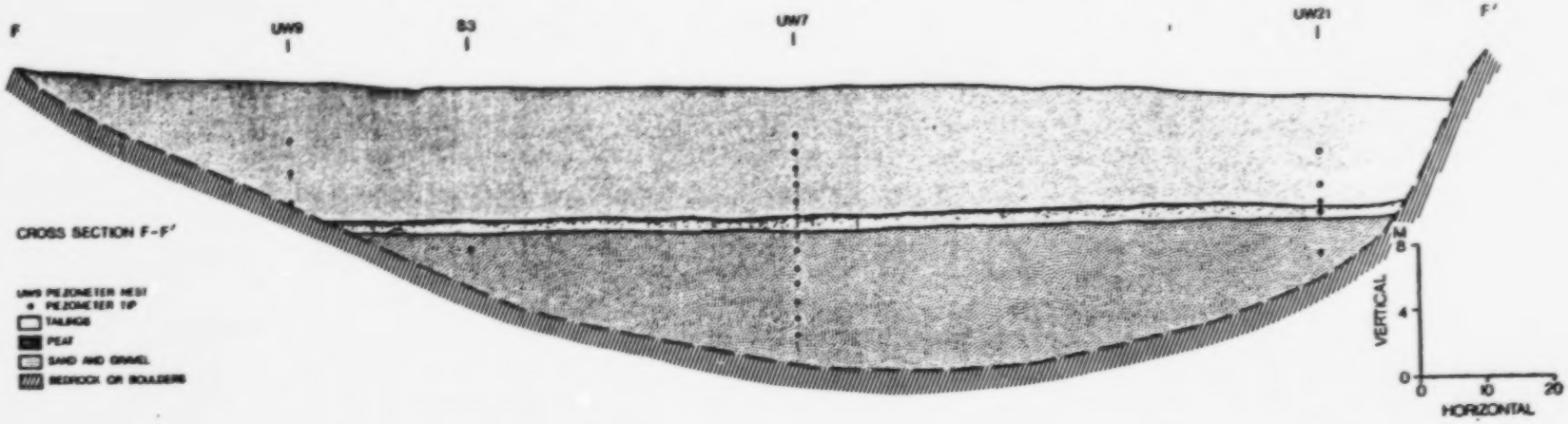

Figure A5 - Stratigraphy And Piezometer Locations Cross Section F-F'.

Appendix B

Water Level Depths and Elevations

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL August 17, 1980		WATER LEVEL August 19, 1980		WATER LEVEL August 21, 1980		WATER LEVEL August 22, 1980		WATER LEVEL August 24, 1980	
			DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION
UW1	P1	346.48[1]	1.90[5]	344.57[6]	1.95[5]	344.52[6]	2.00[8]	344.47[3]	1.70[2]	344.78[1]	1.74[9]	344.73[2]
	P2	346.46[9]	1.89[7]	344.57[2]	1.94[6]	344.52[3]	2.00[6]	344.46[3]	1.65[8]	344.81[1]	1.74[3]	344.72[6]
	P3	346.51[5]	1.95[2]	344.56[3]	2.01[5]	344.50[5]	2.06[2]	344.45[3]	1.71[1]	344.80[4]	1.79[7]	344.75[8]
	P4	346.55[5]	1.98	344.57[5]	2.03[5]	344.57	2.09[2]	344.46[3]	1.72[7]	344.82[8]	1.82[1]	344.73[4]
	P5	346.50[9]	1.94[5]	344.56[9]	1.99[4]	344.51[5]	2.04[6]	344.46[3]	1.56[5]	344.94[9]	1.71[9]	344.79[0]
	P6	346.55[5]	2.26[5]	344.29[0]	2.28[8]	344.26[7]	2.32[2]	344.23[3]	2.21[5]	344.34[0]	2.17[2]	344.38[3]
UW2	P1	346.75[0]	2.06[8]	344.68[2]	2.10[6]	344.64[5]	2.14[4]	344.60[6]	1.98[0]	344.77[7]	1.86[5]	344.88[5]
	P2	346.77[4]	2.08[2]	344.69[2]	2.13[9]	344.64[4]	2.17[1]	344.60[3]	1.92[7]	344.84[7]	1.87[2]	344.90[2]
	P3	346.77[7]	2.07[2]	344.70[5]	2.11[9]	344.65[8]	2.16[8]	344.60[9]	1.84[5]	344.93[2]	1.84[7]	344.93[0]
	P4	346.79[2]	2.10	344.69[2]	2.14[7]	344.64[5]	2.20[0]	344.59[2]	1.75[3]	345.03[9]	1.87[1]	344.92[1]
	P5	346.85	2.16	344.69	2.19[8]	344.65[2]	2.26	344.58[9]	1.78[4]	345.00[8]	1.92[6]	344.92[4]
UW3	P1	347.27[7]	2.65	344.62[7]	2.68[2]	344.59[4]	2.61[9]	344.55[8]	2.70[9]	344.56[8]	2.55[6]	344.72[1]
	P2	347.32[0]	2.60[5]	344.72[0]	2.65[8]	344.66[2]	2.69[7]	344.62[3]	2.64[1]	344.67[9]	2.47[6]	344.84[4]
	P3	347.29[5]	2.55[5]	344.74	2.61[5]	344.68	2.65[6]	344.63[9]	2.58[4]	344.71[1]	2.42[4]	344.87[1]
	P4	347.21[9]	2.46[5]	344.75[4]	2.53	344.68[9]	2.57[1]	344.64[8]	2.44[6]	344.77[3]	2.33[2]	344.88[7]
	P5	347.26[5]	2.50	344.76[5]	dry	-	dry	-	2.43[0]	344.83[5]	2.35[7]	344.90[8]
	P6	347.29[2]	3.31	343.98[2]	3.32[3]	343.96[9]	3.35[0]	343.94[2]	3.29[7]	343.99[5]	3.23[7]	344.05[5]
UW4	P1	347.05	2.45[5]	344.60[5]	2.51[7]	344.53[3]	2.59[9]	344.47[1]	2.25[3]	344.79[7]	2.29[7]	344.75[3]
UW5	P1	346.11[9]	1.66	344.45[9]	1.67[3]	344.44[6]	1.74[3]	344.37[6]	1.66[3]	344.45[6]	1.62[4]	344.49[5]
	P2	346.13[1]	1.68[2]	344.45[1]	1.69	344.44[1]	1.77[5]	344.35[6]	1.55[3]	344.57[8]	1.64[2]	344.48[9]
	P3	346.13[1]	1.68[2]	344.44[9]	1.69[7]	344.44[1]	1.77[7]	344.35[4]	1.56[2]	344.56[9]	1.65[8]	344.47[5]
	P4	346.07[3]	1.63[2]	344.44[1]	1.67[5]	344.43[6]	1.72[6]	344.34[7]	1.49[7]	344.57[6]	1.59[8]	344.47[5]
	P5	346.10[3]	1.68[8]	344.41[5]	1.73[9]	344.42[8]	1.76[8]	344.33[5]	1.49[0]	344.61[3]	1.64[2]	344.46[1]
	P6	346.14[0]	1.77	344.37	1.71	344.40[1]	1.82[4]	344.31[6]	1.44[7]	344.69[3]	1.70[3]	344.43[7]
	P7	346.09	1.69	344.40[0]		344.38	1.75[5]	344.33[5]	1.60[5]	344.48[5]	1.60[2]	344.48[8]
UW6	P1	346.36[3]	1.88[8]	344.48[3]	1.88[7]	344.47[6]	1.926	344.43[7]	1.90[0]	344.46[3]	1.63[4]	344.62[9]
	P2	346.40[5]	2.03[8]	344.36[7]	.2033	344.37	2.09[8]	344.30[7]	1.98[7]	344.41[8]	1.88[6]	344.51[9]
	P3	346.43[0]	2.11[5]	344.32[0]	3.11[1]	344.32	2.17[7]	344.25[3]	1.97[8]	344.45[2]	1.96[9]	344.46[1]
	P4	346.396	21.1[5]	344.28[1]	2.12[1]	344.27[5]	2.18[1]	344.21[5]	1.95[8]	344.43[8]	1.96[9]	344.42[7]
	P5	346.38[1]	2.08[1]	344.30[1]	2.09[5]	344.29	2.15[4]	344.22[7]	1.91[0]	344.47[1]	1.93[0]	344.45[1]
	P6	346.32[6]	2.04[5]	344.28[1]	2.03[7]	344.29[1]	2.116	344.21[0]	1.81	344.51[6]	1.89[2]	344.43
	P7	346.46[6]	1.74	344.72[6]	1.75[2]	344.71[6]	1.79[3]	344.67[3]	1.64[2]	344.82[6]	1.56[8]	344.89[8]

NEST	PIEZOMETER	ELEVATION OF TIP OF PIPE	WATER LEVEL August 17, 1980 DEPTH	ELEVATION	WATER LEVEL August 19, 1980 DEPTH	ELEVATION	WATER LEVEL August 21, 1980 DEPTH	ELEVATION	WATER LEVEL August 22, 1980 DEPTH	ELEVATION	WATER LEVEL August 24, 1980 DEPTH	ELEVATION
UW7	P1	345.86^{9}	3.58^{3}	342.28^{6}	3.59^{4}	342.27^{5}	3.60^{8}	342.26^{1}	3.53^{7}	342.33^{2}	3.52^{7}	342.34^{2}
	P2	345.36^{4}	3.24^{6}	342.62^{0}	3.26^{5}	342.60^{1}	3.27^{3}	342.59^{6}	3.28^{4}	342.56^{3}	3.27^{6}	342.59^{0}
	P3	345.84^{7}	3.22$_{5}$	342.62^{7}	3.24^{8}	342.59^{9}	3.25^{3}	342.59^{2}	3.27^{0}	342.57^{7}	3.24^{6}	342.60^{1}
	P4	345.82^{9}	3.20^{5}	342.62^{4}	3.22^{3}	342.60^{6}	3.23^{4}	342.59^{5}	3.24^{6}	342.58^{3}	3.22^{2}	342.60^{7}
	P5	345.79^{3}	3.18$_{5}$	342.61^{3}	3.20	342.59^{3}	3.21^{2}	342.58^{1}	3.22^{1}	342.57^{2}	3.19^{3}	342.59^{8}
	P6	345.81^{7}	3.20^{5}	342.61^{2}	3.22	342.59^{7}	3.23^{3}	342.58^{4}	3.24^{5}	342.57^{2}	3.21	342.60^{4}
UW8	P1	346.27^{4}	3.52	342.75^{4}	3.53^{9}	342.73^{5}	3.55^{7}	342.71^{7}	3.46^{9}	342.81^{4}	3.45^{1}	342.82^{3}
	P2	346.30^{5}	3.19	343.11^{5}	2.97^{7}	343.33	2.87^{3}	343.43^{2}	2.83^{7}	343.46^{8}	2.74^{1}	343.56^{4}
	P3	346.28^{0}	2.41	343.87^{0}	2.45^{6}	343.82^{4}	2.50^{4}	343.77^{6}	2.42^{8}	343.85^{2}	2.35^{8}	343.92^{2}
	P4	346.26^{8}	2.34^{1}	343.92^{7}	2.39	343.87^{8}	2.43^{8}	343.83	2.29^{8}	343.97	2.27^{2}	343.98^{9}
	P5	346.28^{6}	2.35^{5}	343.93^{1}	2.39^{8}	343.88^{8}	2.45^{4}	343.83^{2}	2.28^{4}	344.00^{2}	2.27^{9}	344.00^{7}
	P6	346.32^{9}	2.40^{2}	343.92^{6}	2.44	343.88^{9}	2.49^{8}	343.83^{1}	2.24^{7}	344.08^{2}	2.32^{4}	344.00^{5}
	P7	346.36^{0}	2.43^{8}	343.92^{2}	2.48	343.88	2.53^{7}	343.82^{3}	2.28^{5}	344.07^{5}	2.35^{9}	344.00^{1}
UW9	P1	346.65^{3}	3.80^{5}	342.84^{8}	3.82^{5}	342.82^{8}	3.84^{3}	350.49^{6}	3.80^{3}	342.85	3.83^{4}	342.81^{9}
	P2	346.62^{9}	3.52^{3}	343.10^{6}	3.54	343.08^{9}	3.55^{5}	343.07^{4}	3.56^{7}	343.06^{2}	3.57^{3}	343.05^{6}
	P3	346.63^{5}	3.50	343.13^{5}	3.51^{8}	343.11^{7}	3.53^{6}	343.09^{9}	3.54^{5}	343.09	3.54^{9}	343.08^{6}
UW10	P1	346.38^{1}	1.94$_{4}$	344.44^{1}	1.91	344.47^{1}	1.92^{2}	344.45^{9}	1.89^{1}	344.49	1.79^{3}	344.58^{8}
	P2	346.37^{8}	1.86^{4}	344.51^{4}	1.91$_{8}$	344.46^{8}	1.94^{2}	344.43^{6}	1.68^{8}	344.69	1.74^{7}	344.63^{1}
	P3	346.39^{0}	1.77^{8}	344.61$_{5}$	1.81^{8}	344.57^{2}	1.87^{8}	344.51^{2}	1.34^{9}	345.05	1.58^{2}	344.80^{8}
	P4	346.39^{6}	1.79^{1}	244.57^{5}	1.82^{7}	344.53^{9}	1.89^{4}	344.47^{2}	1.31^{6}	345.05$_{3}$	1.57^{9}	344.78^{7}
	P5	346.36^{0}	3.21^{5}	343.14^{5}	2.73^{8}	343.62^{2}	2.46^{0}	343.90^{0}	2.34^{7}	344.01^{3}	2.15	344.21^{0}
UW11	P1	346.15^{1}	1.53^{8}	344.62^{1}	1.56^{9}	344.59$_{5}$	1.62^{6}	344.52^{5}	1.60^{3}	344.54^{8}	1.50^{4}	344.64^{7}
	P2	346.20^{7}	1.60^{2}	344.60^{7}	1.63^{5}	344.57^{1}	1.72^{7}	344.48$_{6}$	1.55^{5}	344.65^{2}	1.56^{2}	344.64^{5}
	P3	346.17^{1}	1.57^{2}	344.59^{9}	1.60^{1}	344.57^{1}	1.70^{5}	344.46^{6}	1.42^{5}	344.74^{6}	1.53^{3}	344.63^{8}
	P4	346.20^{1}	1.58	344.62^{1}	1.60^{7}	344.59^{4}	1.73^{2}		1.22^{6}	344.97^{5}	1.538	344.66^{3}
UW12	P1	346.92^{4}	2.52^{5}	344.39^{9}	2.56^{3}	344.36^{1}	2.58^{7}	344.33^{7}	2.54^{5}	344.37^{9}	2.41^{2}	344.51^{2}
	P2	346.95^{4}	2.55^{2}	344.40^{2}	2.58^{7}	344.36^{7}	2.62^{1}	344.33^{3}	2.57^{2}	344.38^{2}	2.44^{4}	344.50^{7}
	P3	346.94^{4}	2.54	344.44^{4}	2.57	344.40^{7}	2.61^{0}	344.33^{4}	2.55^{0}	344.39^{4}	2.42^{4}	344.52^{0}
UW13	P1	347.52^{6}	3.35^{6}	344.17^{0}	3.37^{4}	344.15^{2}	3.38^{8}	344.13^{8}	3.39^{1}	344.13^{5}	3.31^{8}	344.20^{8}
	P2	347.54^{7}	3.37^{8}	344.16^{9}	3.39^{4}	344.15^{3}	3.40^{7}	344.14	3.41^{0}	344.13^{7}	3.33^{7}	344.21^{0}

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL August 17, 1980		WATER LEVEL August 19, 1980		WATER LEVEL August 21, 1980		WATER LEVEL August 22, 1980		WATER LEVEL August 24, 1980	
			DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION
UW14	P1	347.88^{9}	3.69^{5}	344.19^{4}	3.69^{9}	344.19$_{4}$	3.70^{8}	344.18^{1}	3.71^{7}	344.17^{2}	3.66^{1}	344.22^{8}
	P2	347.86^{4}	3.63^{8}	344.23^{6}	3.65	344.22^{4}	3.66^{4}	344.20^{0}	3.67^{2}	344.19^{2}	3.59^{0}	344.27^{4}
	P3	347.87^{5}	-	-	dry	-	dry	-	dry	-	3.22$^{0}_{7}$	-
UW15	P1	346.37^{5}	1.07^{2}	345.30^{3}	1.00^{4}	345.37^{1}	1.04^{8}	345.32^{7}	0.97$_{7}$	345.42^{6}	0.90^{8}	345.46^{7}
	P2	346.39^{6}	1.08^{2}	345.31^{4}	1.06^{1}	345.33^{5}	1.09^{7}	345.29^{7}	0.95$^{7}_{9}$	345.43^{9}	0.95^{3}	345.44^{3}
	P3	346.35^{0}	1.12^{5}	345.22^{5}	1.10^{9}	345.24^{1}	1.12$^{4}_{5}$	345.22^{6}	0.96^{9}	345.42^{7}	0.99^{1}	345.35^{9}
	P4	346.41^{7}	1.21^{2}	345.20^{5}	1.19^{5}	345.22^{2}	1.20^{5}	345.21^{2}	1.04^{4}	345.36^{8}	1.07^{9}	345.33^{8}
	P5	346.62^{7}	0.71^{5}	345.88^{5}	0.71^{5}	345.88^{5}	0.71^{6}	345.91^{1}	0.64^{4}	345.98^{3}	0.60^{9}	346.01^{8}
	P6	346.60^{5}	0.72	345.88^{5}	0.71^{5}	345.88^{5}	0.72^{6}	345.87^{9}	0.64^{6}	345.95^{9}	0.61^{6}	345.98^{8}
UW16	P1	347.22$^{2}_{7}$	3.11^{7}	344.10^{5}	3.08^{7}	344.13^{5}	3.119	344.103	3.11^{3}	344.10^{4}	2.95^{8}	344.26^{4}
	P2	347.22^{7}	2.95^{5}	344.27^{2}	2.99^{4}	344.23^{3}	3.027	344.20$_{4}$	2.99^{2}	344.23^{5}	2.82^{3}	344.40^{4}
	P3	347.22^{4}	2.83^{5}	344.38^{9}	2.88^{2}	344.34^{2}	2.43^{0}	344.29^{4}	2.81^{6}	344.40^{8}	2.67^{8}	344.54^{6}
	P4	347.19^{6}	2.78^{5}	344.41^{1}	2.83^{2}	344.36^{4}	2.88^{6}	344.31	2.75^{2}	344.44^{4}	2.62^{1}	244.57^{5}
UW17	P1	346.62^{5}			3.90^{2}	342.72^{3}	2.33^{2}	344.29^{5}	2.01^{0}	344.61^{5}	1.93^{1}	344.69^{4}
	P2	346.60^{9}			2.04	344.56^{9}	2.14^{3}	344.46^{6}	1.39^{9}	345.21	1.79^{8}	344.81^{1}
UW18	P1	346.12^{2}			1.80^{8}	344.31^{4}	1.88^{3}	344.23^{9}	1.62$_{2}$	344.50^{2}	1.69^{2}	344.43^{0}
	P2	346.11^{1}			2.04^{5}	344.06^{6}	1.91^{8}	344.20	1.55^{2}	344.55^{9}	1.73^{8}	344.37^{3}
UW19	P1	346.74$_{5}$			2.90^{5}	342.83^{5}	2.527	344.21^{3}	2.48^{4}	344.25^{6}	2.35^{3}	344.38^{7}
	P2	346.78^{5}			2.69^{5}	344.09	2.54^{9}	344.23^{6}	2.50^{3}	344.28^{2}	2.30^{3}	344.42^{2}
	P3	346.73^{9}			2.56^{8}	344.19^{1}	2.49^{9}	344.26	2.42^{3}	344.33^{6}	2.29^{2}	344.46^{7}
UW20	P1	346.28^{9}			6.21^{1}	340.06^{9}	2.74	343.54$_{2}$	2.18	344.10$_{4}$	1.82^{6}	344.45^{8}
	P2	346.29^{2}			2.89^{6}	343.39^{6}	1.95$_{4}$	344.34^{2}	1.77^{8}	344.51^{5}	1.78^{2}	344.51^{0}
	P3	346.24^{1}			1.88^{8}	344.35^{6}	1.88^{4}	344.35^{7}	1.58^{6}	344.65^{5}	1.68^{2}	344.55^{9}

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL August 11, 1980 DEPTH	WATER LEVEL August 11, 1980 ELEVATION	WATER LEVEL August 12, 1980 DEPTH	WATER LEVEL August 12, 1980 ELEVATION	WATER LEVEL August 13, 1980 DEPTH	WATER LEVEL August 13, 1980 ELEVATION	WATER LEVEL August 14, 1980 DEPTH	WATER LEVEL August 14, 1980 ELEVATION	WATER LEVEL August 15, 1980 DEPTH	WATER LEVEL August 15, 1980 ELEVATION
UW1	P1	346.48[1]	2.20	344.28[1]	2.07	344.41[1]	2.07	344.41[1]	1.93	344.55[1]	1.81	344.67[1]
	P2	346.46[9]	2.20	344.26[9]	2.05	344.41[9]	2.01[5]	344.45[9]	1.90[5]	344.56[4]	1.80[5]	344.66[9]
	P3	346.51[5]	2.25	344.26[5]	2.10	344.41[5]	2.08	344.43[5]	1.96	344.55[5]	1.86[5]	344.64[3]
	P4	346.55[9]	2.28	344.27[5]	2.13	344.42[5]	2.10[5]	344.45[4]	1.99	344.56[5]	1.89[5]	344.66[9]
	P5	346.50[9]	2.25	344.25[9]	2.07	344.43[9]	2.06[5]	344.44[4]	1.96	344.54[9]	1.82[5]	344.68[9]
	P6	346.55[5]	2.41	344.14[5]	2.36[5]	344.19	2.34	344.21[5]	2.29	344.26[5]	2.25[5]	344.30
UW2	P1	346.75[0]	2.30	344.45[4]	2.24[5]	344.50[5]	2.20[5]	344.55[3]	2.14[5]	344.61	2.06	344.69[4]
	P2	346.77[4]	2.32	344.45[7]	2.24[5]	344.52[9]	2.19[5]	344.58[2]	2.15	344.62[4]	2.05	344,72[7]
	P3	346.77[7]	2.33	344.44[2]	2.22[5]	344.55[7]	2.17[5]	344.60[2]	2.12[5]	344.65[2]	2.02	344.75[2]
	P4	346.79[2]	2.36	344.43	2.20[5]	344.58[7]	2.19	344.60[2]	2.10	344.69[2]	2.02[5]	344.77[0]
	P5	346.85[0]	2.42		2.24	344.61	2.24	344.61	2.14	344.71	2.06[5]	344.79
UW3	P1	347.27[7]	2.73	344.54[7]	2.74	344.53[7]	2.73[5]	344.54[2]	2.70[5]	344.57[2]	2.69	344.58[7]
	P2	347.32[0]	2.73	344.59[0]	2.73	344.59[0]	2.69[5]	344.62[5]	2.67	344.64	2.62[5]	344.69
	P3	347.29[5]	2.70	344.59[5]	2.69	344.60[5]	2.65[5]	344.64[5]	2.63	344.66[5]	2.57[5]	344.72[4]
	P4	347.21[9]	2.61	344.60[9]	2.60	344.61[9]	2.55[5]	344.66[4]	2.54	344.67[9]	2.46[5]	344.75
	P5	347.26[5]	dry		dry		dry		dry		2.47[5]	344.79
	P6	347.29[2]	3.38	343.91[2]	3.36[5]	343.92[7]	3.35[5]	343.93[7]	3.33[5]	343.95[7]	3.31[5]	343.97[7]
UW4	P1	347.05[1]	2.67	344.38[1]	2.54[5]	344.50[6]	2.53	344.52[1]	2.47[5]	344.57[6]	2.38[5]	344.66[6]
UW5	P1	346.11[9]	1.98	344.13[9]	1.86[5]	344.25[4]	1.78[5]	344.33[4]	1.68	344.43[9]	1.52	344.59[9]
	P2	346.13[1]	1.98	344.15[1]	1.77[5]	344.35[6]	1.76[5]	344.36[6]	1.59[5]	344.54[1]	1.50	344.63[1]
	P3	346.13[1]	1.98	344.15[1]	1.77	344.36[1]	1.76[5]	344.36[6]	1.58[5]	344.54[6]	1.50	344.63[1]
	P4	346.07[3]	1.94	344.13[3]	1.71	344.36[3]	1.70[5]	344.36[8]	1.52[5]	344.54[8]	1.43	344.64[3]
	P5	346.10[3]	1.97	344.13[3]	1.71	344.39[3]	1.74[5]	344.36[3]	1.50	344.60[3]	1.48	344.62[3]
	P6	346.14[0]	2.00	344.13[0]	1.68[5]	344.45[5]	1.77[5]	344.36[5]	1.37	344.77[3]	1.54	344.60[0]
	P7	346.09	1.86	344.23[0]	1.78[5]	344.31[5]	1.75[5]	344.33[5]	1.69[5]	344.39[5]	1.65	344.44
UW6	P1	346.36[8]	2.32	344.04[3]	2.13[5]	344.228	2.78[5]	343.578	2.22	344.14[3]	1.92[5]	344.43[8]
	P2	346.40[5]	2.17	344.23[5]	2.06[5]	344.37	2.17[5]	344.23	1.98	344.42[5]	1.90[5]	344.50[5]
	P3	346.43[0]	2.23	344.20[6]	2.06	344.37[6]	2.10	344.33[6]	1.98	344.45[6]	1.96[5]	344.46[5]
	P4	346.39[6]	2.24	344.19[6]	2.05	344.34[6]	2.08	344.31[1]	1.96	344.43[6]	1.97	344.42[6]
	P5	346.38[6]	2.22	344.16[1]	2.08[5]	344.30[1]	2.05	344.33[1]	1.91	344.47[1]	1.92	344.46[6]
	P6	346.32[6]	2.17	344.15[6]	1.90[5]	344.42[1]	1.97	344.356	1.80	344.52[6]	1.84	344.48[6]
	P7	346.46[6]	2.08	344.38[6]	1.81[5]	344.65[1]	1.88[5]	344.58[1]	1.72[5]	344.74[1]	1.68	344.78[6]

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL August 11, 1980		WATER LEVEL August 12, 1980		WATER LEVEL August 13, 1980		WATER LEVEL August 14, 1980		WATER LEVEL August 15, 1980	
			DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION	DEPTH	ELEVATION
UW7	P1	345.86^{9}	3.67	342.19^{1}	3.63^{5}	342.23^{4}	3.90^{3}	341.96^{4}	3.61	342.25^{9}	3.57^{5}	342.29^{4}
	P2	345.86^{6}	3.22	342.64^{6}	3.22	342.64^{6}	3.60^{5}	342.26^{9}	3.25	342.61^{6}	3.24^{5}	342.62^{1}
	P3	345.84^{7}	3.17	342.67^{7}	3.20$_{50}$	342.64^{7}	3.20	342.64^{7}	3.21	342.63^{7}	3.22	342.62^{7}
	P4	345.82^{9}	3.15	342.67^{9}	3.17	342.65^{4}	3.18	342.64^{9}	3.19	342.63^{9}	3.20$_{5}$	342.62^{9}
	P5	345.79^{3}	3.14	342.63^{2}	3.15$_{5}$	342.64^{3}	3.16	342.63^{3}	3.17	342.62^{3}	3.17^{5}	342.61^{8}
	P6	345.81^{7}	3.16	242.65^{7}	3.17^{5}	342.64^{2}	3.18	342.63^{7}	3.19	342.62^{7}	3.20	342.61^{7}
UW8	P1	346.27^{4}	3.57	342.70^{4}	3.56$_{5}$	342.71^{4}	3.55	342.72^{4}	3.53	342.74^{4}	3.50^{5}	342.76^{9}
	P2	346.30^{5}	5.99	340.31^{5}	5.21^{5}	341.09	4.63$_{5}$	341.67^{5}	4.08	342.22^{5}	3.69	342.61^{5}
	P3	346.28^{0}	2.89	343.39	2.64	343.64	2.52^{5}	343.75	2.46$_{5}$	343.82	2.39	343.89
	P4	346.26^{8}	2.53	343.73^{8}	2.46	343.80^{8}	2.39^{5}	343.87^{3}	2.35^{5}	343.91^{3}	2.27	343.99^{8}
	P5	346.28^{6}	2.53	343.75^{8}	2.43$_{5}$	343.85^{6}	2.40^{5}	343.88^{1}	2.36	343.92^{6}	2.27$_{5}$	344.01^{6}
	P6	346.32^{9}	2.57	343.75^{9}	2.43^{5}	343.89^{4}	2.44	343.88^{9}	2.35	343.97^{5}	2.29^{5}	344.03^{4}
	P7	346.36^{0}	2.61	343.75	2.47	343.89	2.48	343.88	2.39	343.97	2.31^{5}	344.025
UW9	P1	346.65^{3}	3.75	342.90^{3}	3.76^{5}	342.88^{8}	3.77$_{5}$	342.88^{3}	3.78	342.87^{3}	3.79$_{5}$	342.86^{3}
	P2	346.62^{9}	3.45	343.17^{9}	3.47	343.15^{9}	3.47^{5}	343.15^{4}	3.49$_{5}$	343.13^{9}	3.50^{5}	343.12^{4}
	P3	346.63^{5}	3.43	343.20^{5}	3.44	343.19^{5}	3.45	343.18^{5}	3.46^{5}	343.17^{1}	3.48	343.15^{5}
UW10	P1	346.38^{1}	4.42	341.96	3.46^{5}	342.91^{6}	2.86	343.52^{1}	2.42$_{5}$	343.96^{1}	2.14^{5}	344.21^{6}
	P2	346.37^{8}	1.97	344.40^{8}	1.90	344.47^{8}	1.90	344.47^{8}	1.83^{5}	344.54^{3}	1.80^{5}	344.57^{3}
	P3	346.39^{0}	1.93	344.46	1.78	344.61$_{6}$	1.84$_{5}$	344.55	1.67^{5}	344.61^{5}	1.62^{5}	344.76^{5}
	P4	346.36^{6}	1.96	344.42	1.76	344.60^{6}	1.81^{5}	344.55^{1}	1.62	344.64^{5}	1.62^{5}	344.74^{1}
	P5	346.39^{0}	8.16	338.20	6.90	339.46	5.87	340.49	-	-	4.18	342.18
UW11	P1	346.15^{1}					4.41$_{5}$	341.74^{1}	2.48^{5}	343.66^{6}	1.72	244.43^{1}
	P2	346.20^{7}					2.44^{5}	343.76^{2}	1.68	344.52^{7}	1.44$_{5}$	344.76^{7}
	P3	346.17^{1}					1.84^{5}	344.32^{6}	1.53^{5}	344.64	1.36^{5}	344.80^{6}
	P4	346.20^{1}					1.74	344.46	1.37^{5}	344.82^{6}	1.30	344.90^{1}
UW12	P1	346.92^{4}							2.68^{5}	344.23^{9}	2.55^{5}	344.36^{9}
	P2	346.95^{4}							2.63$_{5}$	344.32$_{9}$	2.58	344.37^{4}
	P3	346.94^{4}							2.62^{5}	344.31^{9}	2.56	344.38^{8}
UW13	P1	347.52^{6}									3.38	344.14^{6}
	P2	347.54^{7}									3.40	344.14^{7}

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL DEPTH August 11, 1980	WATER LEVEL ELEVATION August 11, 1980	WATER LEVEL DEPTH August 12, 1980	WATER LEVEL ELEVATION August 12, 1980	WATER LEVEL DEPTH August 13, 1980	WATER LEVEL ELEVATION August 13, 1980	WATER LEVEL DEPTH August 14, 1980	WATER LEVEL ELEVATION August 14, 1980	WATER LEVEL DEPTH August 15, 1980	WATER LEVEL ELEVATION August 15, 1980
UW14	P1	347.88^{9}							4.14	343.74^{9}	3.78^{5}	344.14^{4}
	P2	347.86^{4}							3.65	344.21^{4}	3.65^{5}	344.20^{9}
	P3	347.87^{5}							-	-	-	-
UW15	P1	346.37^{5}									2.13	344.24^{5}
	P2	346.39^{6}									1.02	345.37^{6}
	P3	346.35^{0}									1.04^{5}	345.31^{5}
	P4	346.41^{7}									1.13^{5}	345.28^{2}
	P5	346.62^{7}									0.85	345.77^{5}
	P6	346.60^{5}									0.70	345.70^{5}
UW16	P1	347.22^{2}									5.02	342.20^{2}
	P2	346.22^{7}									4.03	343.19^{7}
	P3	346.22^{6}									2.87	344.35^{6}
	P4	347.19^{6}									2.87^{5}	344.32^{1}

TEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 3 DEPTH	WATER LEVEL September 3 ELEVATION	WATER LEVEL September 7 DEPTH	WATER LEVEL September 7 ELEVATION	WATER LEVEL September 9 DEPTH	WATER LEVEL September 9 ELEVATION
W1	P1	346.48	1.86	344.62	1.98	344.50	1.95	344.53
	P2	346.47	1.86	344.61	1.98	344.49	1.94	344.53
	P3	346.52	1.91	344.61	2.03	344.49	1.99	344.53
	P4	346.56	1.94	344.62	2.06	344.50	2.02	344.54
	P5	346.51	1.88	344.63	2.02	344.49	1.99	344.52
	P6	346.56	2.17	344.39	2.27	344.29	2.27	344.29
W2	P1	346.75	1.90	344.85	2.02	344.73	2.02	344.73
	P2	346.78	1.92	344.86	2.04	344.74	2.04	344.74
	P3	346.78	1.89	344.89	2.02	344.76	2.02	344.76
	P4	346.79	1.92	344.87	2.05	344.74	2.01	344.78
	P5	346.86	1.98	344.88	2.10	344.76	2.04	344.82
	P6	346.82	2.50	344.32	2.59	344.23	2.59	344.23
W3	P1	347.28	2.57	344.71	2.66	344.62	2.68	344.60
	P2	347.33	2.55	344.78	2.65	344.68	2.67	344.66
	P3	347.30	2.51	344.79	2.61	344.69	2.63	344.67
	P4	347.22	2.42	344.80	2.52	344.70	2.56	344.66
	P5	347.27	2.45	344.82	2.57	344.70	2.60	344.67
	P6	347.29	3.19	344.10	3.26	344.03	3.29	344.00
W4	P1	347.05	2.39	344.66	2.50	344.55	2.50	3.4454
W5	P1	346.12	1.64	344.48	1.79	344.33	1.78	344.34
	P2	346.14	1.66	344.48	1.81	344.33	1.73	344.41
	P3	346.14	1.66	344.48	1.81	344.33	1.74	344.40
	P4	346.08	1.60	344.48	1.76	344.32	1.68	344.40
	P5	346.11	1.63	344.48	1.79	344.32	1.67	344.44
	P6	346.15	1.65	344.50	1.82	344.33	1.57	344.58
	P7	346.09	1.62	344.47	1.72	344.37	1.72	344.37
W6	P1	346.36	1.88	344.48	1.96	344.40	1.95	344.41
	P2	346.41	2.06	344.35	2.13	344.28	2.08	344.33
	P3	346.43	2.13	344.30	2.19	344.24	2.12	344.31
	P4	346.40	2.14	344.26	2.20	344.20	2.11	344.29
	P5	346.38	2.10	344.28	2.16	344.22	2.07	344.31
	P6	346.33	2.06	344.27	2.12	344.21	1.99	344.34
	P7	346.46	1.72	344.74	1.80	344.66	1.77	344.69

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION	WATER LEVEL DEPTH	WATER LEVEL ELEVATION	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
			September 3		September 7		September 9	
UW7	P1	345.86^{9}	3.49^{3}	342.37^{6}	3.53$_{5}$	342.33^{9}	3.53^{6}	342.33^{3}
	P2	345.86^{6}	3.25	342.61^{6}	3.28^{5}	342.58^{1}	3.30^{1}	342.56^{5}
	P3	345.84^{7}	3.23$_{5}$	342.61^{7}	3.26^{5}	342.58^{2}	3.29^{2}	342.55^{5}
	P4	345.82^{9}	3.20^{5}	342.64^{4}	3.25$_{5}$	342.57^{9}	3.26^{3}	342.56^{6}
	P5	345.79^{3}	3.18$_{8}$	342.61^{3}	3.22^{5}	342.56^{8}	3.24^{2}	342.55^{1}
	P6	345.81^{7}	3.19	342.61^{9}	3.24	342.57^{7}	3.25^{7}	342.56^{0}
UW8	P1	346.27^{4}	3.43	342.84^{4}	3.47^{5}	342.79^{9}	3.49^{4}	342.78^{0}
	P2	346.30^{5}	2.65$_{5}$	343.65^{5}	2.66^{5}	343.64^{0}	2.69^{6}	343.60^{9}
	P3	346.28^{0}	2.41^{5}	343.86^{5}	2.51^{5}	343.76^{5}	2.52^{2}	343.75^{8}
	P4	346.26^{8}	2.35^{5}	343.91^{3}	2.45^{5}	343.81^{3}	2.45^{9}	343.80^{9}
	P5	346.28^{6}	2.37	343.91^{6}	2.46^{5}	343.82^{1}	2.46^{5}	343.82^{1}
	P6	346.32^{9}	2.41	343.91^{9}	2.50	343.82^{9}	2.47^{0}	343.85^{9}
	P7	346.36^{0}	2.45	343.91	2.54	343.82	2.51^{0}	343.85
UW9	P1	346.65^{3}	3.84^{5}	342.80^{8}	3.86^{5}	342.78^{8}	3.87^{7}	342.77^{6}
	P2	346.62^{9}	3.57^{5}	343.05^{4}	3.59^{5}	343.03^{4}	3.60^{9}	343.02^{9}
	P3	346.63^{5}	3.55	343.08^{5}	3.57	343.06^{5}	3.58^{6}	343.04^{9}
UW10	P1	346.38^{1}	1.76	344.62^{1}	1.86	344.52^{1}	1.88^{9}	344.49^{2}
	P2	346.37^{8}	1.82	344.55^{8}	1.91	344.46^{8}	1.89^{0}	344.48^{8}
	P3	346.39^{0}	1.72	344.67	1.85	344.54	1.79^{3}	344.59^{7}
	P4	346.36^{6}	1.73	344.63^{6}	1.86$_{5}$	344.50^{6}	1.75^{1}	344.61^{5}
	P5	346.36^{0}	1.86	344.50	1.85^{5}	344.50^{5}	1.87^{4}	344.48^{6}
UW11	P1	346.15^{1}	1.53	344.62^{1}	1.70^{5}	344.44^{6}	1.73^{7}	344.41^{4}
	P2	346.20^{7}	1.63$_{5}$	344.57^{7}	1.70^{5}	344.41^{2}	1.77^{3}	344.43^{4}
	P3	346.17^{1}	1.61^{5}	344.55^{6}	1.76^{5}	344.40^{6}	1.71^{8}	344.45^{3}
	P4	346.20^{1}	1.63	344.57^{1}	1.70	344.41^{1}	1.69^{2}	344.50^{9}
	P5	346.19^{1}	-	-	1.87	344.32^{1}	1.87^{9}	344.31^{2}
UW12	P1	346.92^{4}	2.41	344.51^{4}	2.49^{5}	344.42^{9}	2.50^{2}	344.42^{2}
	P2	346.95^{4}	2.44	344.51^{4}	2.52$_{5}$	344.43^{4}	2.53^{7}	344.41^{7}
	P3	346.94^{4}	2.42	344.52^{4}	2.51^{5}	344.42^{9}	2.54^{1}	344.40^{3}
	P4	346.89^{6}	2.43	344.46^{6}	2.50^{5}	344.39^{1}	2.52^{9}	344.36^{7}

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 3 DEPTH	WATER LEVEL September 3 ELEVATION	WATER LEVEL September 7 DEPTH	WATER LEVEL September 7 ELEVATION	WATER LEVEL September 9 DEPTH	WATER LEVEL September 9 ELEVATION
UW13	P1	347.52^{6}	3.26	344.26^{6}	3.32	344.20^{6}	3.35^{7}	344.16^{9}
	P2	347.54^{7}	3.27^{5}	344.27^{2}	3.34	344.20^{7}	3.37^{2}	344.17^{5}
	P3	347.52^{1}	3.35	344.17^{1}	3.38$_{5}$	344.14^{1}	3.41^{1}	344.11
	P4	347.53	3.30^{5}	344.22^{5}	3.36^{5}	344.16^{5}	3.392	344.13^{8}
UW14	P1	347.88^{9}	3.55	344.33^{9}	3.60^{5}	344.28^{4}	3.63^{5}	344.25^{4}
	P2	347.86^{4}	3.52	344.34^{4}	3.56	344.30^{4}	3.60^{4}	344.26
	P3	347.87^{5}	dry	-	dry	-	dry	-
	P4	347.77^{2}	3.58	344.19^{2}	3.50$_{5}$	344.27^{2}	3.53^{7}	344.23^{5}
	P5	347.75^{0}	3.49	344.26	3.45^{5}	344.29^{5}	3.48^{9}	344.26^{1}
UW15	P1	346.37^{5}	1.05^{5}	346.32	1.08^{5}	345.29	1.03^{9}	345.33^{6}
	P2	346.39^{6}	1.11	345.28^{6}	1.12^{5}	345.27^{1}	1.03^{3}	345.36^{3}
	P3	346.35^{0}	1.15	345.20^{0}	1.15	345.20^{0}	1.01^{8}	345.33^{2}
	P4	346.41^{7}	1.23^{5}	345.18^{2}	1.23	345.18^{7}	1.08^{7}	345.33^{0}
	P5	346.62^{7}	0.75	345.87^{7}	0.76^{5}	345.86^{2}	0.71^{6}	345.91^{1}
	P6	346.60^{5}	0.76	345.84^{5}	0.77	345.83^{5}	0.71^{9}	345.88^{6}
JW16	P1	347.22^{2}	2.91	344.31$_{2}$	3.00^{5}	344.21^{7}	3.04^{9}	344.17^{3}
	P2	347.22^{7}	2.81	344.41^{7}	2.90^{5}	344.32^{2}	2.94^{7}	344.28^{1}
	P3	347.22^{6}	2.70	344.52^{6}	2.81	344.41^{6}	2.86^{0}	344.36^{6}
	P4	347.19^{6}	2.66	344.53^{6}	2.76	344.43^{6}	2.81^{1}	344.38^{5}
	P5	347.10^{3}	3.04	344.06^{3}	3.06^{5}	344.03^{8}	3.11^{0}	343.99^{3}
JW17	P1	346.62^{5}	2.05	344.57^{5}	2.24	344.38^{5}	2.25^{6}	344.36^{9}
	P2	346.60^{9}	1.95	344.65^{9}	2.15	344.45^{9}	2.00^{7}	344.60^{2}
	P3	346.57^{8}	uncut		2.36	344.21^{8}	2.39^{6}	344.18^{2}
JW18	P1	346.12^{2}	1.75	344.37^{2}	1.885	344.23^{7}	1.85^{9}	344.26^{3}
	P2	346.11^{1}	1.79^{5}	244.31^{6}	1.91^{5}	344.19^{6}	1.79^{9}	344.31^{3}
W19	P1	346.74^{0}	2.36^{5}	344.37^{5}	2.45	344.29	2.47^{8}	344.26^{2}
	P2	346.78^{5}	2.36$_{5}$	344.42^{5}	2.46^{5}	344.32$_{4}$	2.48^{2}	344.30^{3}
	P3	346.75^{9}	2.31^{5}	344.44^{4}	2.40^{5}	344.35^{4}	2.43^{0}	344.32^{9}
	P4	346.69^{3}	2.42^{5}	344.27^{3}	2.40^{5}	344.28^{8}	2.41^{1}	344.28^{2}

P7 346.46

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 3 DEPTH	WATER LEVEL September 3 ELEVATION	WATER LEVEL September 7 DEPTH	WATER LEVEL September 7 ELEVATION	WATER LEVEL September 9 DEPTH	WATER LEVEL September 9 ELEVATION
UW20	P1	346.28^{0}	1.81$_{5}$	344.46^{5}	1.91^{5}	344.36^{5}	1.92^{9}	344.35^{1}
	P2	346.29^{2}	1.85$_{5}$	344.43^{7}	1.92$_{5}$	344.37^{2}	1.92^{1}	344.37^{1}
	P3	346.24^{1}	1.76^{5}	344.47^{6}	1.88^{5}	344.35^{6}	1.82^{1}	344.42^{0}
UW21	P1	345.45^{7}	3.37$_{5}$	342.08^{7}	3.39^{5}	342.06^{2}	3.39^{7}	342.06$_{7}$
	P2	345.49^{3}	4.19^{0}	341.29^{8}	3.19^{5}	342.29^{8}	3.16^{6}	342.32^{7}
	P3	345.52^{9}	3.53^{5}	341.99^{9}	3.14	342.38^{9}	3.18^{3}	342.34^{6}
	P4	345.54^{3}	3.10^{5}	342.43^{8}	3.17$_{5}$	342.37^{3}	3.15^{7}	342.38^{6}
	P5	345.48^{4}	2.96^{5}	342.51^{9}	3.05^{5}	342.43^{9}	3.07^{0}	342.41^{4}
UW22	P1				10.02^{5}		9.99^{0}	
	P2				8.16^{5}		8.04^{8}	
	P3				dry		-	
UW23	P1	347.32^{9}			5.13	342.19^{7}	2.93^{6}	344.39^{3}
UW24	P1	346.45^{9}			4.69	341.76^{9}	2.85^{6}	343.60^{3}
	P2	346.51^{6}			7.56$_{5}$	338.95^{6}	3.11^{0}	343.40^{6}
	P3	346.47^{8}			2.07^{5}	344.40^{3}	1.99^{8}	344.48
UW25	P1							
	P2							
UW26	P1							
	P2							
UW	S1	347.32^{3}						
UW	S2	346.84					3.29^{8}	344.02^{5}
	S2^{1}	346.80^{1}					2.48^{3}	344.35^{7}
UW	S3	346.29^{9}					2.83	343.97^{1}
							3.86^{8}	342.43^{1}

EST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL Sept. 4/80 DEPTH	ELEVATION	WATER LEVEL Sept. 6/80 DEPTH	ELEVATION	WATER LEVEL Sept. 9/80 DEPTH	ELEVATION
W3	C.S.	347.21	3.10	344.11	3.13	344.08	3.20	344.01
bundle)	1		3.11	344.10	3.15	344.06	3.21	344.00
	2		3.12	344.09	3.16	344.05	3.22	343.99
	3		3.12	344.09	3.14	344.07	3.21	344.00
	4		3.13	344.08	3.17	344.04	3.23	343.98
	5		3.13	344.08	3.17	344.04	3.22	343.99
	6		3.14	344.07	3.17	344.04	3.22	343.99
	7		3.14	344.07	3.17	344.04	3.23	343.98
	8		3.15	344.06	3.17	344.04	3.23	343.98
W5	C.S.	346.10	1.81	344.29	1.77	344.32		
bundle)	1		1.13	344.97	1.71	344.39		
	2		1.61	344.48	1.70	344.39		
	3		1.64	344.48	1.71	344.39		
	4		1.64	344.45	1.71	344.38		
	5		1.64	344.46	1.70	344.39		
	6		1.64	344.46	1.70	344.39		
W6	C.S.	346.46	1.82	344.64	1.80	344.66		
bundle)	1		1.70	344.76	1.73	344.72		
	2		1.69	344.77	1.73	344.72		
	3		1.70	344.75	1.74	344.71		
	4		1.71	344.75	1.75	344.71		
	5		1.71	344.75	1.76	344.70		
	6		1.74	344.72	1.78	344.67		
W7	C.S.	345.75	3.44	342.31	3.47	342.28		
bundle)	1		3.44	342.31	3.47	342.28		
	2		3.44	342.31	3.47	342.28		
	3		3.44	342.31	3.47	342.28		
	4		3.45	342.30	3.48	342.27		
	5		3.45	342.30	3.48	342.27		
	6		3.46	342.29	3.49	342.26		

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL DEPTH Sept. 4/80	WATER LEVEL ELEVATION Sept. 4/80	WATER LEVEL DEPTH Sept. 6/80	WATER LEVEL ELEVATION Sept. 6/80	WATER LEVEL DEPTH Sept. 9/80	WATER LEVEL ELEVATION Sept. 9/80
UW23 (bundle)	C.S.	347.48[3]						
	1						3.52	343.96[3]
	2						3.54	343.94[3]
	3						3.52	343.96[3]
	4						3.60	343.88[3]
							3.38	344.10[3]

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 26 DEPTH	WATER LEVEL September 26 ELEVATION	WATER LEVEL October 9 DEPTH	WATER LEVEL October 9 ELEVATION	WATER LEVEL October 14 DEPTH	WATER LEVEL October 14 ELEVATION
UW1	P1	346.48	1.36	345.12	1.53	344.94	1.53	344.95
	P2	346.46	1.34	345.12	1.54	344.92	1.53	344.93
	P3	346.51	1.40	345.11	1.59	344.92	1.58	344.92
	P4	346.55	1.42	345.13	1.62	344.93	1.61	344.94
	P5	346.50	1.27	345.23	1.54	344.96	1.55	344.95
	P6	346.55	1.91	344.64	1.90	344.65	1.90	344.65
UW2	P1	346.75	1.48	345.26	1.62	345.12	1.62	345.12
	P2	346.77	1.44	345.33	1.65	345.11	1.65	345.12
	P3	346.77	1.36	345.41	1.63	345.14	1.63	345.14
	P4	346.79	1.34	345.44	1.67	345.11	1.66	345.12
	P5	346.85	1.41	345.43	1.72	345.12	1.71	345.13
	P6	346.81	2.31	344.50	2.29	344.52	2.29	344.52
UW3	P1	347.27	2.45	344.82	2.43	344.84	2.43	344.83
	P2	347.32	2.40	344.91	2.41	344.90	2.40	344.91
	P3	347.29	2.35	344.93	2.37	344.92	2.37	344.92
	P4	347.21	2.26	344.95	2.28	344.93	2.27	344.94
	P5	347.26	2.28	344.97	2.31	344.95	2.30	344.95
	P6	347.29	3.02	344.26	2.97	344.32	2.97	344.32
UW4	P1	347.65	2.06	344.99	2.23	344.81	2.23	344.81
UW5	P1	346.11	1.22	344.88	1.19	344.92	1.27	344.84
	P2	346.13	1.22	344.90	1.28	344.84	1.33	344.79
	P3	346.13	1.22	344.90	1.28	344.84	1.33	344.79
	P4	346.07	1.16	344.91	1.22	344.84	1.28	344.78
	P5	346.10	1.18	344.91	1.26	344.83	1.32	344.77
	P6	346.14	1.20	344.93	1.29	344.84	1.35	344.79
	P7	346.09	1.34	344.74	1.37	344.71	1.37	344.71
UW6	P1	346.36	1.69	344.67	*2.36	343.99	1.76	344.59
	P2	346.40	1.84	344.56	1.98	344.41	1.96	344.44
	P3	346.43	1.91	344.51	2.07	344.35	2.06	344.36
	P4	346.39	1.91	344.48	2.07	344.32	2.06	344.33
	P5	346.38	1.86	344.51	2.03	344.34	2.02	344.35
	P6	346.32	1.75	344.56	1.97	344.34	1.98	344.34
	P7	346.46	1.50	344.96	1.57	344.89	1.56	344.89

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 26 DEPTH	WATER LEVEL September 26 ELEVATION	WATER LEVEL October 9 DEPTH	WATER LEVEL October 9 ELEVATION	WATER LEVEL October 14 DEPTH	WATER LEVEL October 14 ELEVATION
UW7	P1	345.86^{9}	3.37$^{0}_{7}$	342.49^{9}	3.33$^{6}_{5}$	342.53$^{3}_{1}$	3.31^{0}	342.55^{9}
	P2	345.86$^{6}_{7}$	3.21^{6}	342.64^{9}	3.17^{2}	342.69^{5}	3.14^{9}	342.71^{7}
	P3	345.84^{9}	3.19^{6}	342.65^{1}	3.12^{5}	342.72^{4}	3.12^{0}	342.72^{9}
	P4	345.82^{9}	3.16^{1}	342.66^{8}	3.09^{5}	342.73^{7}	3.10^{8}	342.72^{5}
	P5	345.79^{3}	3.13^{6}	342.65^{7}	3.07^{6}	342.71^{9}	3.08^{6}	342.70^{7}
	P6	345.81^{7}	3.14^{3}	342.67^{4}	3.08^{8}	342.72	3.10	342.71
UW8	P1	346.27$^{4}_{5}$	3.27^{5}	342.99$^{9}_{7}$	3.24$^{1}_{3}$	343.03^{3}	3.23$^{3}_{8}$	343.04$^{1}_{7}$
	P2	346.30^{0}	2.61^{8}	343.68^{7}	2.41^{3}	343.89$^{2}_{5}$	2.41^{9}	343.88^{1}
	P3	346.28^{0}	2.16^{6}	344.11^{4}	2.21$^{5}_{7}$	344.06^{5}	2.21^{9}	344.06^{1}
	P4	346.26^{8}	2.05^{9}	344.20^{9}	2.16^{7}	344.10^{1}	2.16^{2}	344.10^{6}
	P5	346.28^{6}	2.05^{6}	344.23^{0}	2.18	344.10^{6}	2.17^{2}	344.11^{4}
	P6	346.32^{9}	2.08^{5}	344.24^{4}	2.22^{7}	344.10$^{2}_{3}$	2.21^{6}	344.11^{3}
	P7	346.36^{0}	2.12^{0}	344.24^{0}	2.26^{7}	344.09^{3}	2.25^{8}	344.10^{2}
UW9	P1	346.65^{3}	3.84^{1}	342.81$^{2}_{7}$	3.77^{8}	342.87^{5}	3.77^{0}	342.88$^{3}_{9}$
	P2	346.62$^{9}_{5}$	3.60^{2}	343.02^{4}	3.52^{6}	343.10$^{3}_{5}$	3.53^{0}	343.09^{9}
	P3	346.63^{5}	3.57^{1}	343.06^{4}	3.50^{0}	343.13^{5}	3.50^{4}	343.13^{1}
UW10	P1	346.38^{1}	1.63$_{3}$	344.75$^{1}_{5}$	1.63^{5}	344.74$^{6}_{2}$	1.66$^{1}_{2}$	344.72^{0}
	P2	346.37^{8}	1.58^{3}	344.79^{9}	1.70^{6}	344.67^{2}	1.69^{2}	344.68^{6}
	P3	346.39^{0}	1.33^{1}	346.05^{9}	1.62^{1}	344.76^{9}	1.60^{6}	344.78^{4}
	P4	346.36^{6}	1.36^{4}	345.00^{2}	1.63^{1}	344.73^{5}	1.59^{8}	344.76^{8}
	P5	346.36^{0}	1.76^{1}	344.59^{9}	1.69^{5}	344.66^{5}	1.70^{5}	344.65^{5}
UW11	P1	346.15^{1}	1.19^{9}	344.95^{2}	1.14$_{7}$	345.00^{4}	1.20$_{5}$	344.95^{1}
	P2	346.20^{7}	1.20^{6}	345.00^{1}	1.25^{0}	344.95^{7}	1.29^{3}	344.91$^{2}_{8}$
	P3	346.17^{1}	1.15^{7}	345.01$_{4}$	1.24^{2}	344.92^{9}	1.27^{6}	344.89^{5}
	P4	346.20^{1}	1.12^{9}	345.07^{2}	1.27^{6}	344.92^{5}	1.30^{8}	344.89$^{5}_{3}$
	P5	346.19^{1}	1.50^{6}	344.68^{5}	1.52^{6}	344.66^{5}	1.51^{8}	344.67^{3}
UW12	P1	346.92^{4}	2.14^{5}	344.77^{9}	2.13^{6}	344.78^{8}	2.12^{7}	344.79^{7}
	P2	346.95^{4}	2.18^{1}	344.77^{3}	2.16^{7}	344.78^{7}	2.15^{5}	344.79^{9}
	P3	346.94^{4}	2.17^{3}	344.77^{1}	2.14^{8}	344.79^{6}	2.13^{6}	344.80^{8}
	P4	346.89^{6}	2.19^{8}	344.69^{8}	2.15^{2}	344.74^{4}	2.14^{5}	344.75^{1}

NEST	PIEZOMETER	ELEVATION OF TOP OF PIPE	WATER LEVEL September 26 DEPTH	WATER LEVEL September 26 ELEVATION	WATER LEVEL October 9 DEPTH	WATER LEVEL October 9 ELEVATION	WATER LEVEL October 14 DEPTH	WATER LEVEL October 14 ELEVATION
UW13	P1	347.52^{6}	3.21^{4}	344.31^{2}	3.14^{9}	344.37^{7}	3.14^{9}	344.37^{7}
	P2	347.54^{7}	3.23^{2}	344.31^{5}	3.16^{5}	344.38^{2}	3.16^{3}	344.38^{4}
	P3	347.52^{1}	3.29^{2}	344.22^{9}	3.22^{6}	344.30^{1}	3.22^{5}	344.29^{6}
	P4	347.53	3.25^{3}	344.27^{7}	3.18^{5}	344.34^{5}	3.19^{1}	344.33^{9}
UW14	P1	347.88^{9}	3.49^{0}	344.39^{7}	3.38^{6}	344.50^{3}	3.39^{0}	344.49^{9}
	P2	347.86^{4}	3.44^{7}	344.41^{7}	3.33^{8}	344.52^{6}	3.33^{8}	344.52^{6}
	P3	347.87^{5}	dry	-	dry	-	dry	-
	P4	347.77^{2}	3.36^{7}	344.40^{4}	3.27^{1}	344.50^{1}	3.26^{9}	344.51^{2}
	P5	347.75	3.33^{1}	344.41^{9}	3.23^{0}	344.52	3.23	344.52
UW15	P1	346.37^{5}	0.93^{2}	345.44^{3}	1.02^{2}	345.35^{3}	1.04^{1}	345.33^{4}
	P2	346.39^{6}	0.98^{3}	345.41^{3}	1.11^{6}	345.28^{6}	1.10^{5}	345.29^{1}
	P3	346.35^{0}	1.00^{6}	345.34^{4}	1.14^{7}	345.203	1.13^{2}	345.21^{8}
	P4	346.41^{7}	1.09^{0}	345.32^{7}	1.22^{4}	345.19^{3}	1.20^{4}	345.21^{3}
	P5	346.62^{7}	0.68^{7}	345.94	0.76^{8}	345.85^{9}	0.78^{0}	345.84^{7}
	P6	346.60^{5}	0.69^{8}	345.90^{7}	0.783	345.82^{2}	0.77^{4}	345.83^{1}
UW16	P1	347.22^{2}	2.73^{6}	344.48^{6}	2.68^{6}	344.53^{6}	2.69^{0}	344.53^{2}
	P2	347.22^{7}	2.61^{8}	344.60^{9}	2.58^{9}	344.63^{8}	2.58^{8}	344.63^{9}
	P3	347.22^{6}	2.50^{1}	344.72^{5}	2.49^{6}	344.73^{0}	2.49^{1}	344.73^{5}
	P4	347.19^{6}	2.44^{8}	344.74^{8}	2.44^{5}	344.75^{1}	2.44^{1}	344.75^{5}
	P5	347.10^{3}	2.79^{9}	344.30^{4}	2.72^{9}	344.37^{4}	2.73^{2}	344.37^{1}
UW17	P1	346.62^{5}	1.60^{5}	345.02	1.74^{9}	344.87^{6}	1.74^{2}	344.88^{3}
	P2	346.60^{9}	1.28^{3}	345.32^{6}	broken	-	1.55^{3}*	345.05^{6}*
	P3	346.57^{8}	1.85^{3}	344.72^{5}	1.89^{4}	344.68^{4}	1.88^{0}	344.69^{8}
UW18	P1	346.12^{2}	1.34^{9}	344.77^{3}	1.38^{4}	344.73^{8}	1.38^{0}	344.74^{2}
	P2	346.11^{1}	1.31^{0}	344.80^{1}	1.39^{8}	344.71^{3}	1.38^{3}	344.72^{8}
UW19	P1	346.74^{0}	2.07^{2}	344.66^{8}	2.12^{1}	344.619	2.12^{0}	344.62^{0}
	P2	346.78^{5}	2.06^{7}	344.71^{8}	2.12^{8}	344.65^{7}	2.13^{3}	344.65^{2}
	P3	346.75^{9}	1.97^{3}	344.78^{6}	2.05^{8}	344.70^{1}	2.06^{9}	344.69^{0}
	P4	346.69^{3}	2.01^{8}	344.67^{5}	2.05^{6}	344.63^{7}	2.06^{9}	344.62^{4}

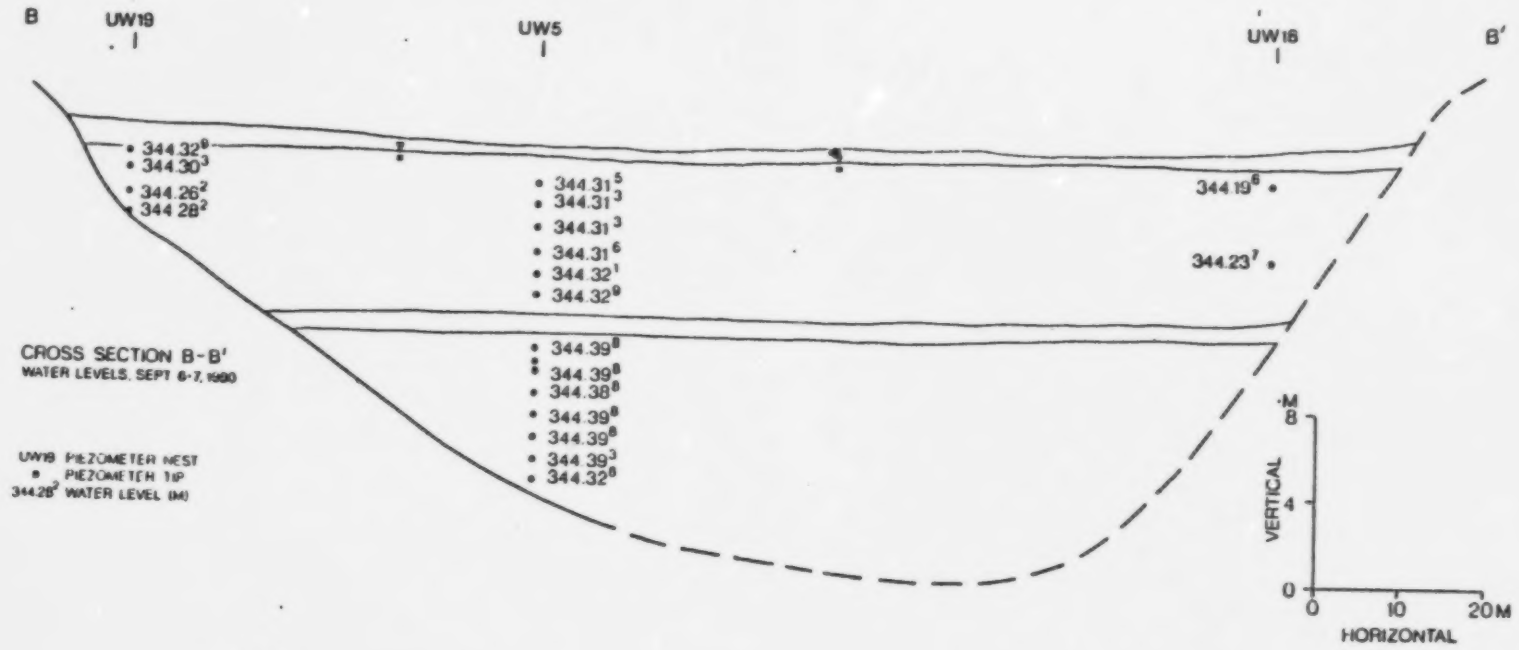

Figure B1 - Water Level Elevations, September 9, 1980 Cross Section B-B'.

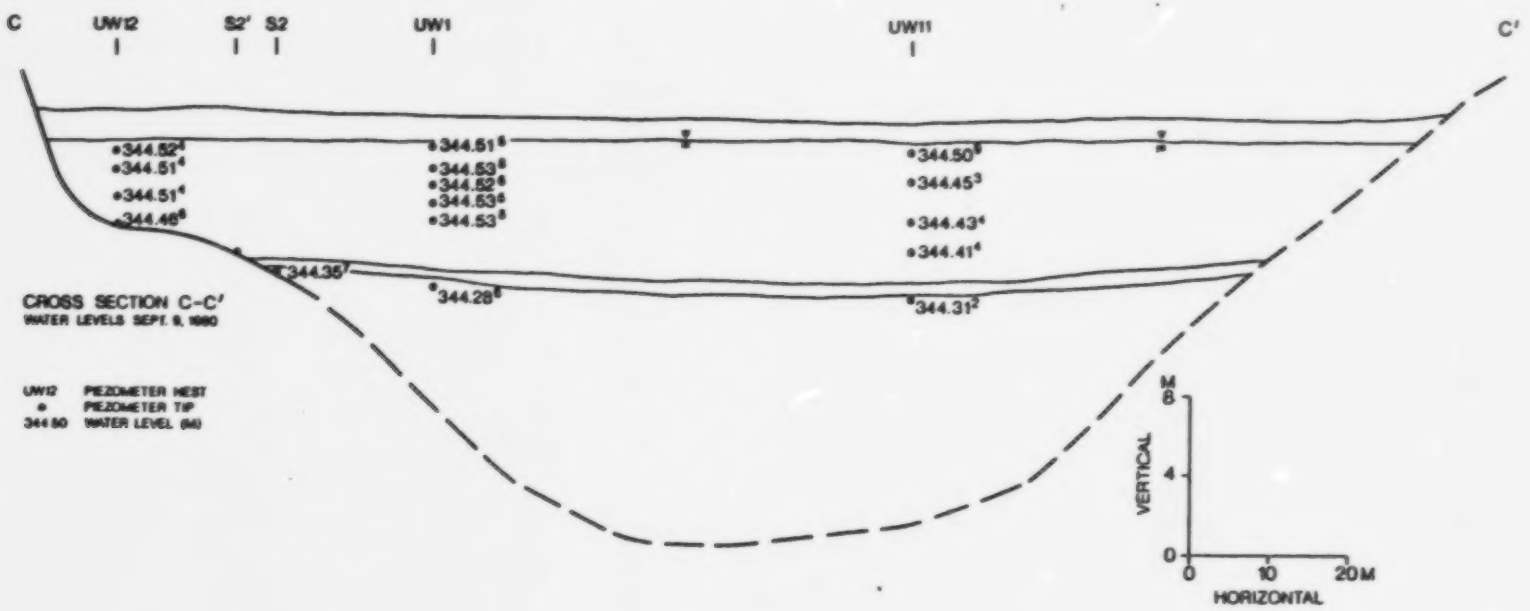

Figure B2 - Water Level Elevations, September 9, 1980 Cross Section C-C'.

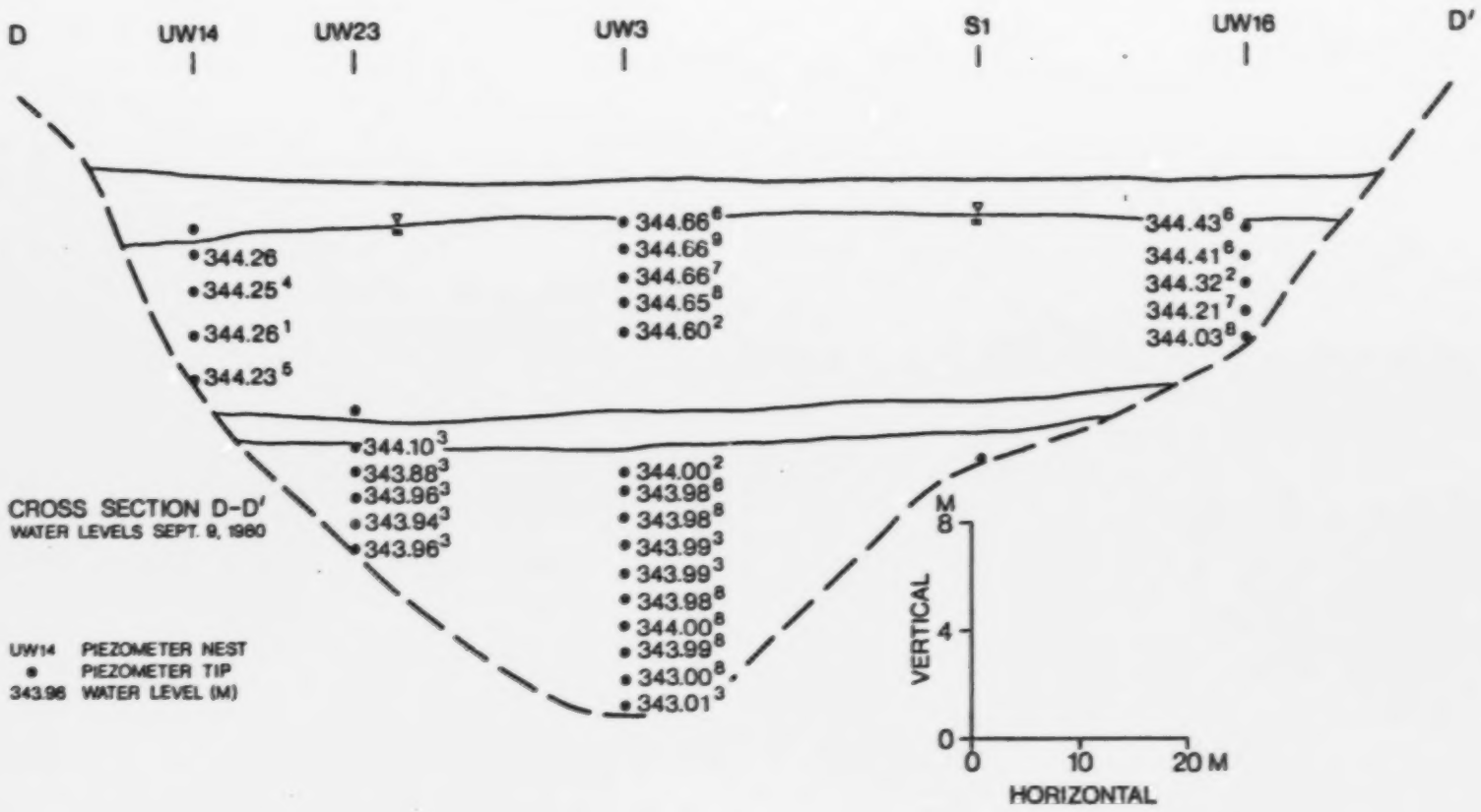

Figure B3 - Water Level Elevations, September 9, 1980 Cross Section D-D'.

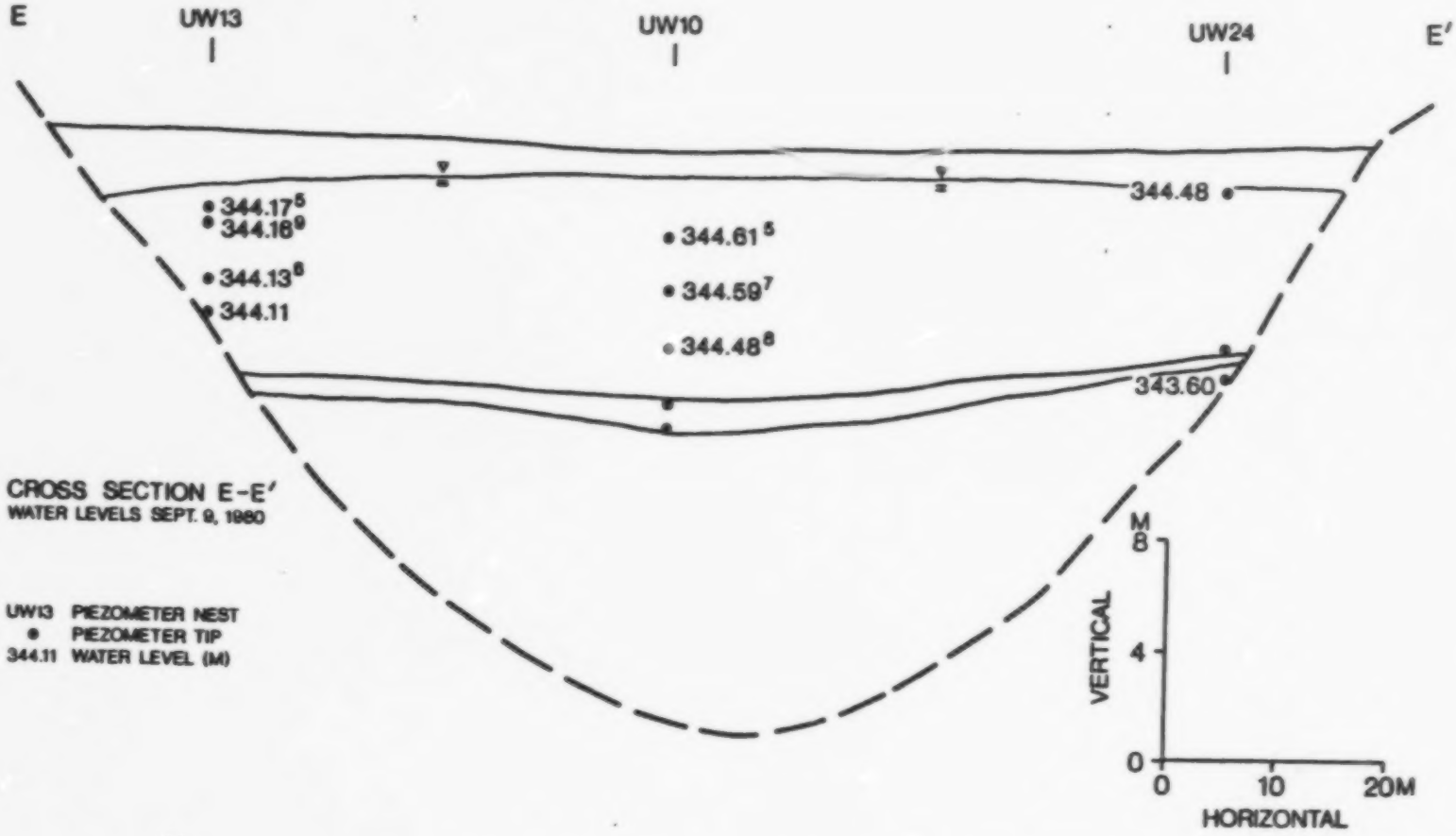

Figure B4 - Water Level Elevations, September 9, 1980 Cross Section E-E'.

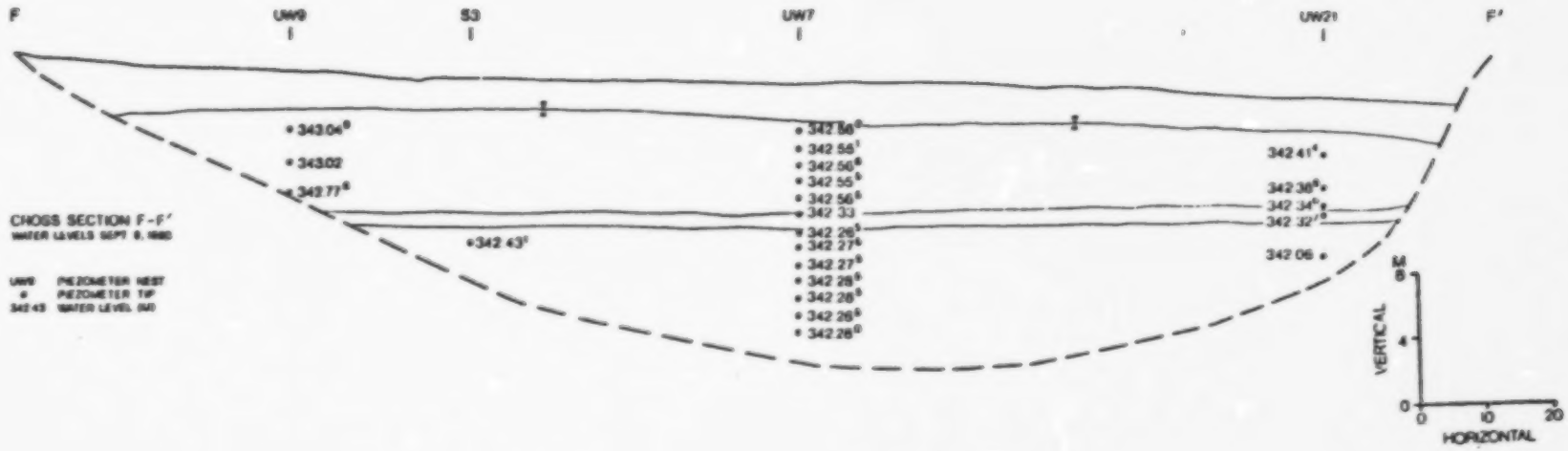

Figure B5 - Water Level Elevations, September 9, 1980 Cross Section F-F'.

Appendix C

Precipitation Data

DATE MEASURED	TIME OF MEASUREMENT	RECORDED PRECIPITATION (cm)
05/08/80	8:10 am	0.18
12/08/80	8:00 am	1.61
14/08/80	9:00 am	1.52
15/08/80	8:40 am	2.22
18/08/80	8:20 am	0.01
19/08/80	8:10 am	0.03
22/08/80	8:00 am	4.37
09/09/80	8:00 am	0.69
15/09/80	9:50 am	2.84
17/09/80	9:20 am	3.50

Table C1 - Recorded Precipitation at the West Arm Nordic Tailings from August 5 1980 to Sept. 17, 1980.

Appendix D

Field Measurements of Electrical Conductance and pH

NEST	PIEZOMETER	DATE SAMPLED	TEMPERATURE °C	pH	ELECTRICAL CONDUCTANCE µS
UW1	P1	Aug. 12/80	13.0	6.00	4 500
	P2		14.0	5.70	5 000
	P3		15.0	5.80	6 000
	P4		18.0	5.90	4 200
	P5		16.0	4.60	8 600
	P6		11.0	6.00	3 500
UW6	P1	Aug. 12/80	14.0	6.50	2 800
	P2		-	6.50	2 890
	P3		12.0	6.50	3 100
	P4		-	5.80	6 400
	P5		17.0	5.30	6 000
	P6		16.5	4.45	5 000
	P7		12.5	6.00	3 000
UW7	P1	Aug. 12/80	14.0	5.8	3 250
	P2		13.0	6.2	3 200
	P3		12.0	6.1	4 100
	P4		13.0	5.4	4 050
	P5		14.0	4.2	5 000
	P6		15.5	3.8	5 100
UW10	P2	Aug. 12/80	12.0	5.7	3 700
	P3		15.0	4.1	4 400
	P4		15.0	5.3	7 100

NEST	PIEZOMETER	DATE SAMPLED	TEMPERATURE (°C)	pH	ELECTRICAL CONDUCTANCE µS
UW1	P1	Sept. 11/80	19.0	6.10	5 000
	P2		16.0	6.00	4 000
	P3		18.0	5.90	5 500
	P4		16.5	6.50	4 500
	P5		21.0	4.35	9 000
	P6		16.0	6.10	3 600
UW2	P1	Sept. 11/80	19.0	6.05	4 500
	P2		19.5	5.55	4 500
	P3		20.5	4.50	4 600
	P4		20.0	4.60	6 200
	P5		18.0	4.80	5 500
	P6		14.0	6.05	3 200
UW3	P1	Sept. 11/80	16.0	2.55	7 200
	P2		16.0	3.00	7 500
	P3		18.5	3.60	7 200
	P4		19.5	1.55	11 000
	P5				
	P6		13.0	6.0	1 200
UW4	P1	-	-	-	-
UW5	P1	Sept. 12/80	7.20	7.20	2 900
	P2		7.50	7.50	2 900
	P3		7.30	7.30	2 780
	P4		7.05	7.05	3 000
	P5		6.75	6.75	3 390
	P6		6.75	6.75	3 700
	P7		6.1	6.10	600
UW6	P1	Sept. 14/80	11.5	7.05	2 600
	P2		11.5	7.30	2 500
	P3		12.5	7.40	2 880
	P4		12.0	6.05	5 700
	P5		13.0	6.10	5 100
	P6		14.0	6.20	4 400
	P7		11.0	6.10	2 800
UW7	P1	Sept. 12/80	12.0	6.20	2 850
	P2		11.0	6.75	2 900
	P3		12.5	6.80	4 100
	P4		11.5	6.40	3 900
	P5		13.0	4.15	5 800
	P6		13.5	3.95	5 400

NEST	PIEZOMETER	DATE SAMPLED	TEMPERATURE (°C)	pH	ELECTRICAL CONDUCTANCE µS
UW8	P1	Sept. 12/80	10.5	4.85	2 200
	P2		12.5	6.80	2 950
	P3		11.5	7.25	3 500
	P4		11.5	6.50	3 450
	P5		11.5	5.90	4 350
	P6		13.0	6.00	5 600
	P7		13.0	5.50	6 300
UW9	P1	Sept. 12/80	13.0	4.85	6 600
	P2		11.0	3.95	6 000
	P3		12.0	2.00	6 000
UW10	P1	Sept. 12/80			
	P2		11.0	6.5	3 480
	P3		11.0	5.85	4 000
	P4		13.0	6.00	8 100
UW11	P1	Sept. 11/80	13.5	6.60	3 400
	P2		16.5	6.35	4 400
	P3		18.0	6.80	4 600
	P4		21.5	6.65	4 200
	P5		13.0	6.00	750
UW12	P1	Sept. 10/80	11.5	5.7	2 800
	P2		12.0	4.0	2 800
	P3		15.5	3.95	2 150
	P4		14.0	5.3	2 300
UW13	P1	Sept. 12/80	13.5	1.70	7 200
	P2		13.0	1.85	6 000
	P3		12.5	3.40	4 500
	P4		12.5	3.80	4 650
UW14	P1	Sept. 10/80	14.0	1.38	21 500
	P2		14.0	1.38	23 500
	P3				
	P4		13.0	1.45	14 000
	P5		13.5	1.50	15 000
UW15	P1	Sept. 14/80	11.0	7.20	3 060
	P2		11.0	7.60	2 950
	P3		12.0	6.50	4 000
	P4		13.0	6.10	4 100
	P5		12.0	6.10	3 040
	P6		12.0	6.20	3 000

NEST	PIEZOMETER	DATE SAMPLED	TEMPERATURE (°C)	pH	ELECTRICAL CONDUCTANCE µS
UW16	P1	Sept. 11/80	15.0	3.9	6 000
	P2		18.5	4.75	6 200
	P3		16.5	4.75	6 000
	P4		18.0	3.75	5 900
	P5		15.0	5.3	5 100
UW17	P1	Sept. 11/80	14.0	6.0	3 880
	P2		15.0	5.95	8 500
	P3		16.0	6.35	1 830
UW18	P1	Sept. 14/80	11.5	6.3	980
	P2		13.5	6.3	1 620
UW19	P1	Sept. 14/80	12.0	4.10	4 100
	P2		13.0	3.15	3 050
	P3		13.5	2.40	-
	P4		12.0	4.35	4 200
UW20	P1	Sept. 14/80	11.5	6.80	3 050
	P2		13.0	6.05	4 300
	P3		15.0	3.90	5 000
UW21	P1	Sept. 12/80	12.0	6.50	1 360
	P2		12.5	6.50	3 050
	P3		13.0	6.60	3 800
	P4		12.5	6.70	3 650
	P5		13.0	5.50	2 400
UW23	P1	Sept. 11/80	17.0	6.0	3 400
UW24	P1	Sept. 12/80	11.5	4.75	2 500
	P2		10.5	6.75	3 500
	P3		12.5	4.80	-
UW25	P1	Sept. 14/80		6.85	2 550
	P2			4.50	5 200
UW26	P1	Sept. 14/80	14.5	5.85	2 300
	P2		12.5	6.65	2 180
UW	S1	Sept. 11/80	13	6.0	2 500
UW	S2 S2[1]				
UW	S3	Sept. 12/80	10.5	6.2	2 500

NEST	PIEZOMETER	DATE SAMPLED	TEMPERATURE °C	pH	ELECTRICAL CONDUCTANCE µS
UW3	C.S.	Sept. 15/80	11.0	7.60	640
(bundle)	1		10.5	6.20	620
	2		11.5	5.90	530
	3		12.0	5.90	500
	4		12.0	5.95	560
	5		12.0	5.85	590
	6		13.0	5.85	510
	7		12.5	5.90	530
	8		13.0	6.00	850
UW5	C.S.	Sept. 17/80	11.0	7.10	1 650
(bundle)	1		11.0	6.55	1 320
	2		11.5	6.40	630
	3		11.5	6.80	900
	4		11.0	6.50	410
	5		11.0	6.45	330
	6		11.0	6.40	810
UW6	C.S.	Sept. 19/80	10.0	6.20	2 500
(bundle)	1		10.5	6.10	2 550
	2		10.0	6.00	2 450
	3		10.5	6.10	2 400
	4		10.5	6.00	2 600
	5		10.0	6.00	2 480
	6		10.5	6.20	2 500
UW7	C.S.	Sept. 15/80	11.5	6.15	2 500
(bundle)	1		13.0	6.10	2 420
	2		14.0	6.10	2 500
	3		16.0	6.10	2 650
	4		15.5	6.00	2 640
	5		16.0	6.05	2 700
	6		16.0	6.00	3 180
UW23	C.S.	Sept. 14/80	12.0	6.15	3 450
(bundle)	1		13.0	6.30	3 200
	2		12.5	6.20	2 600
	3		11.0	4.75	3 400
	4		13.5	4.80	3 250

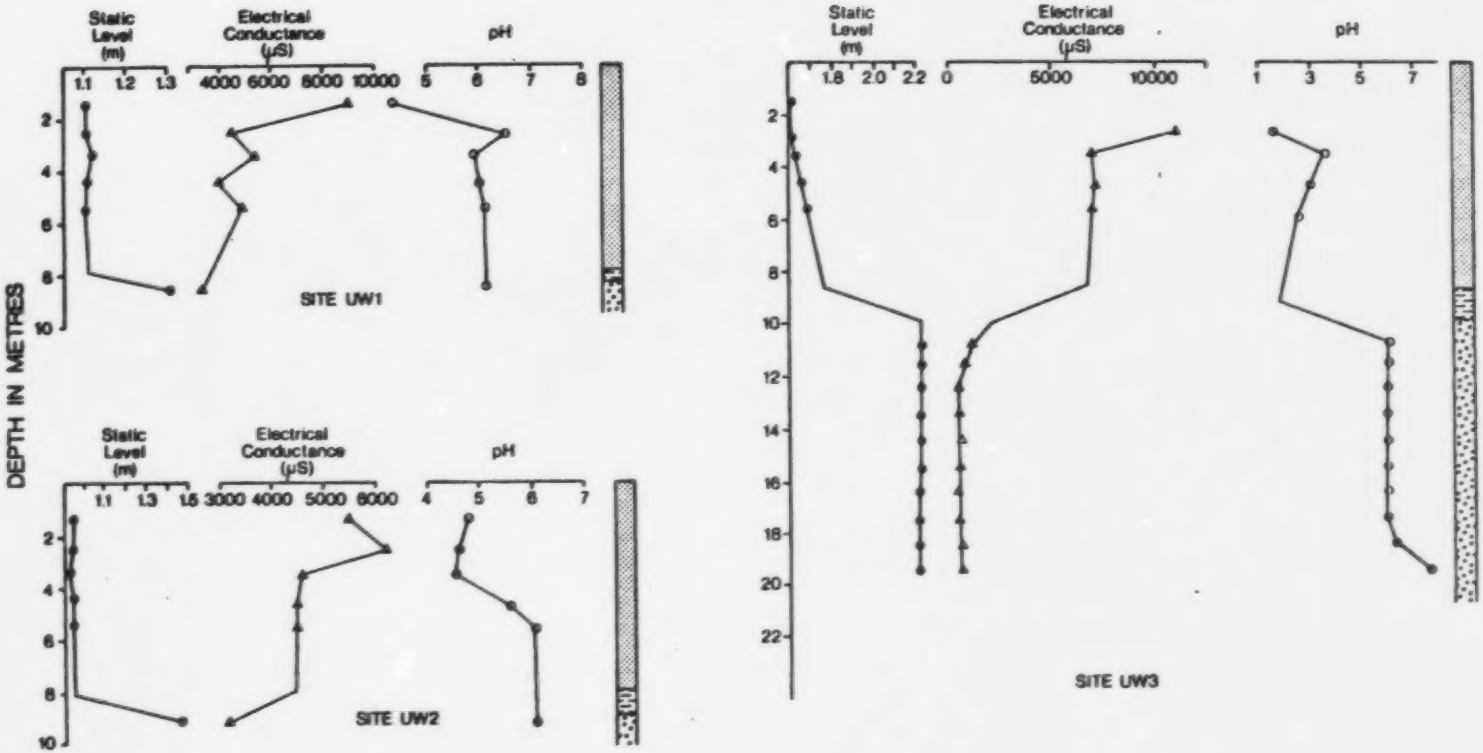

Figure D1 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW1, UW2, UW3.

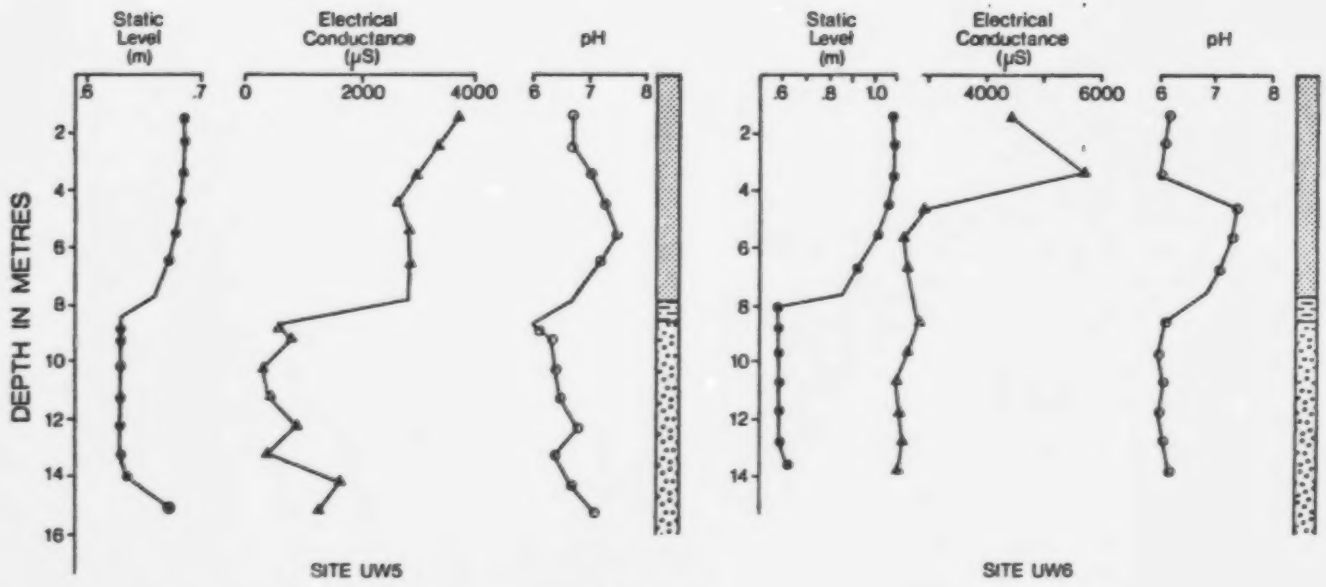

Figure D2 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW5, UW6.

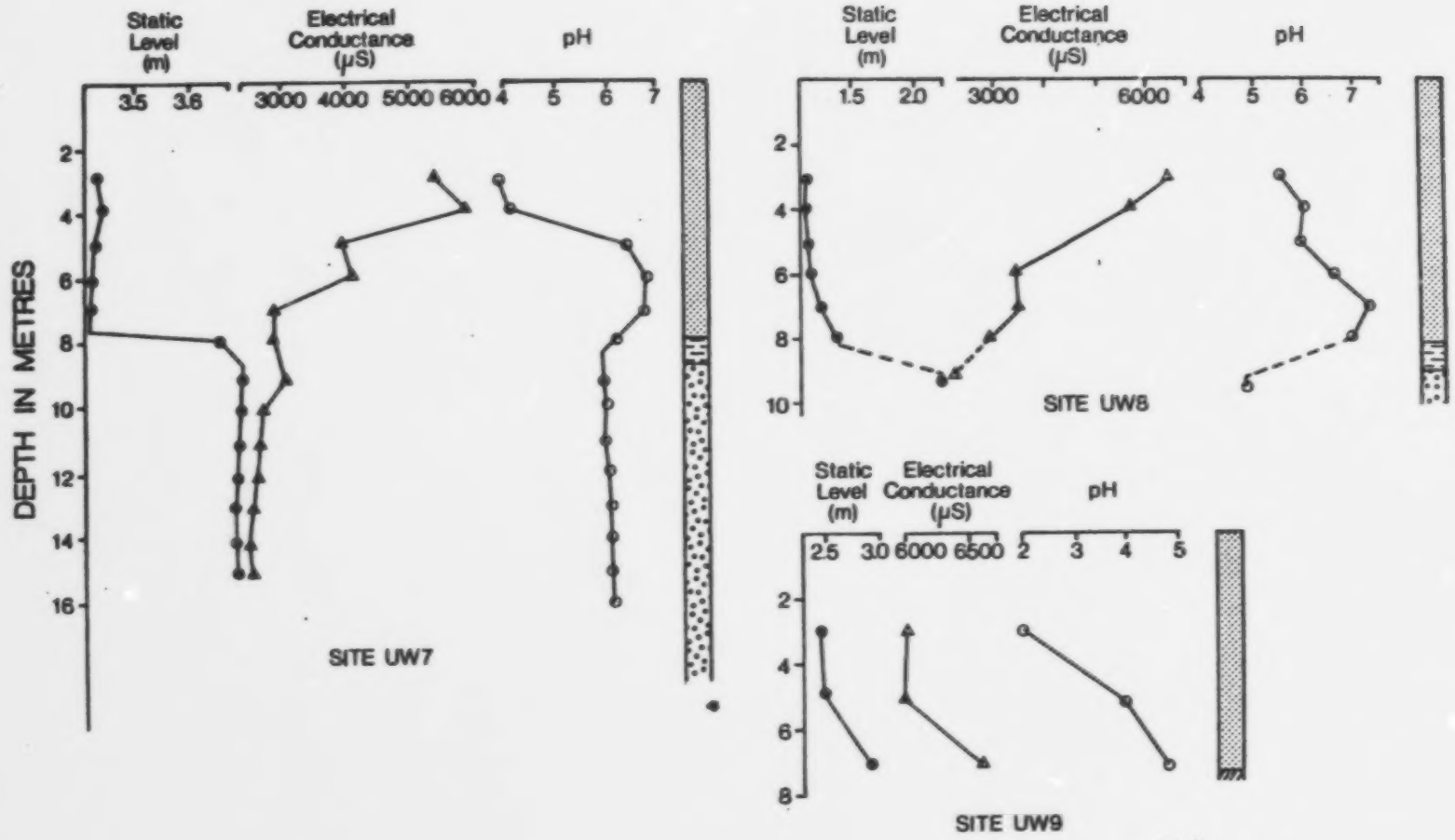

Figure D3 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW7, UW8, UW9.

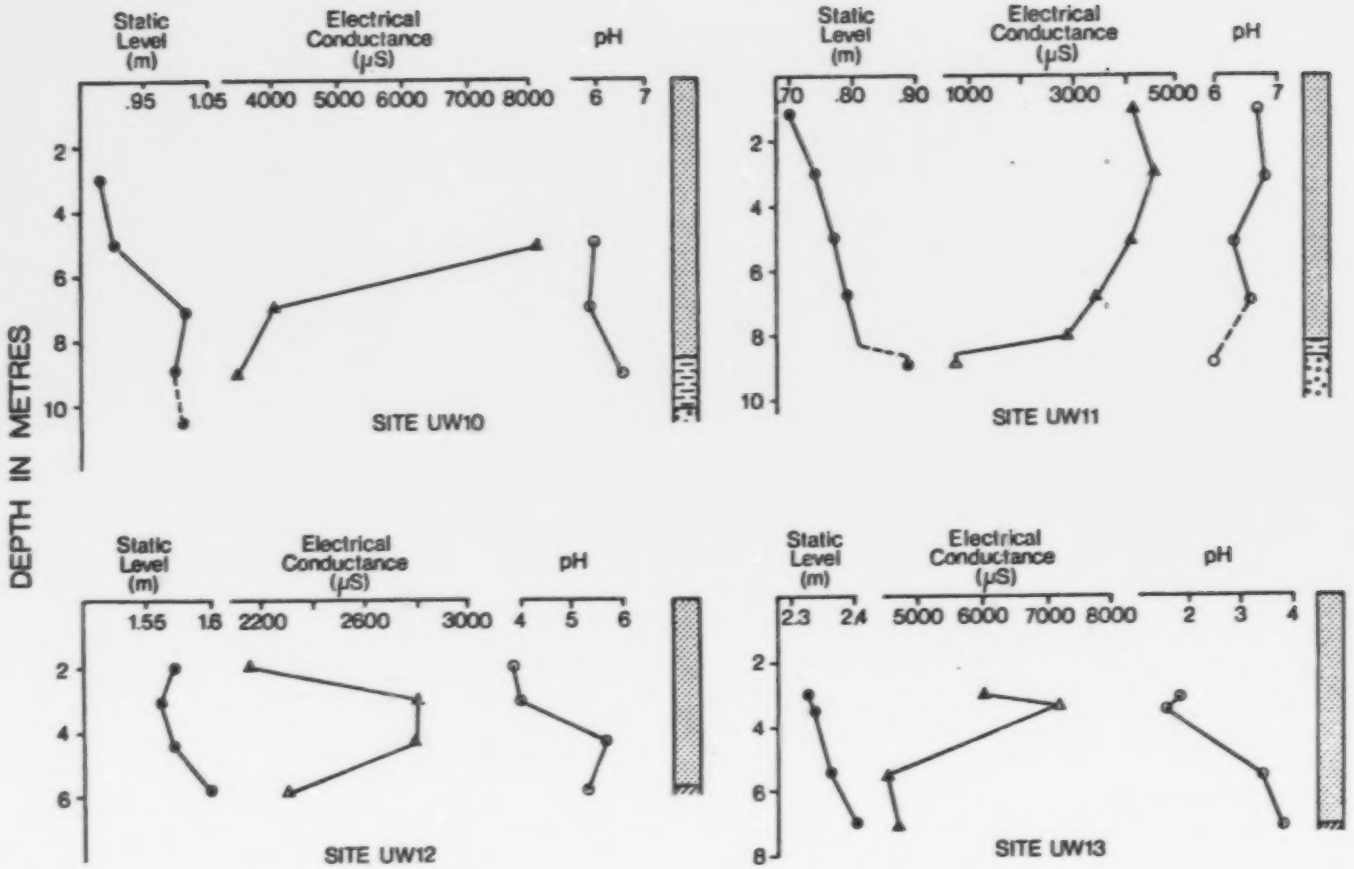

Figure D4 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW10, UW11, UW12, UW13.

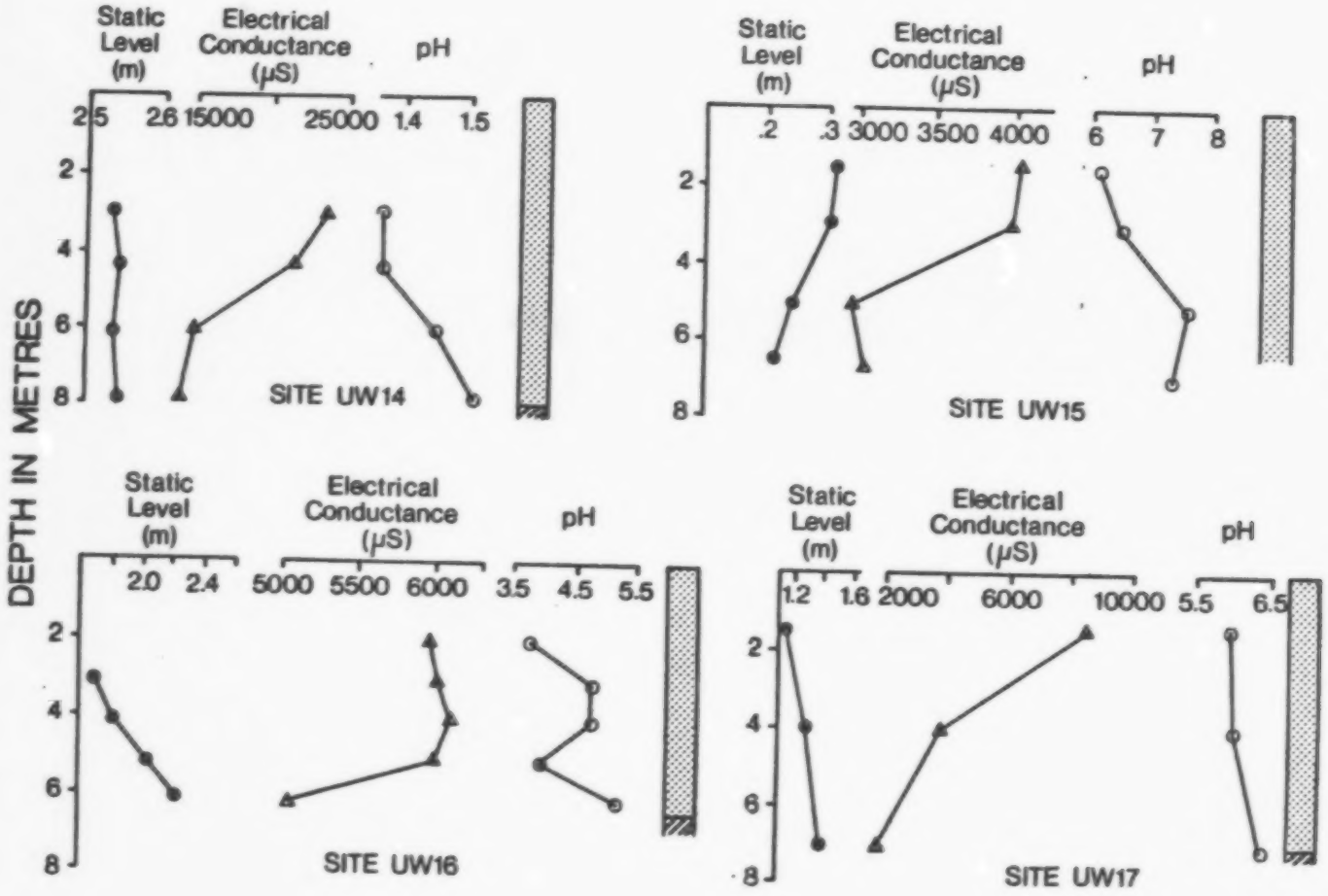

Figure D5 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW14, UW15, UW16, UW17.

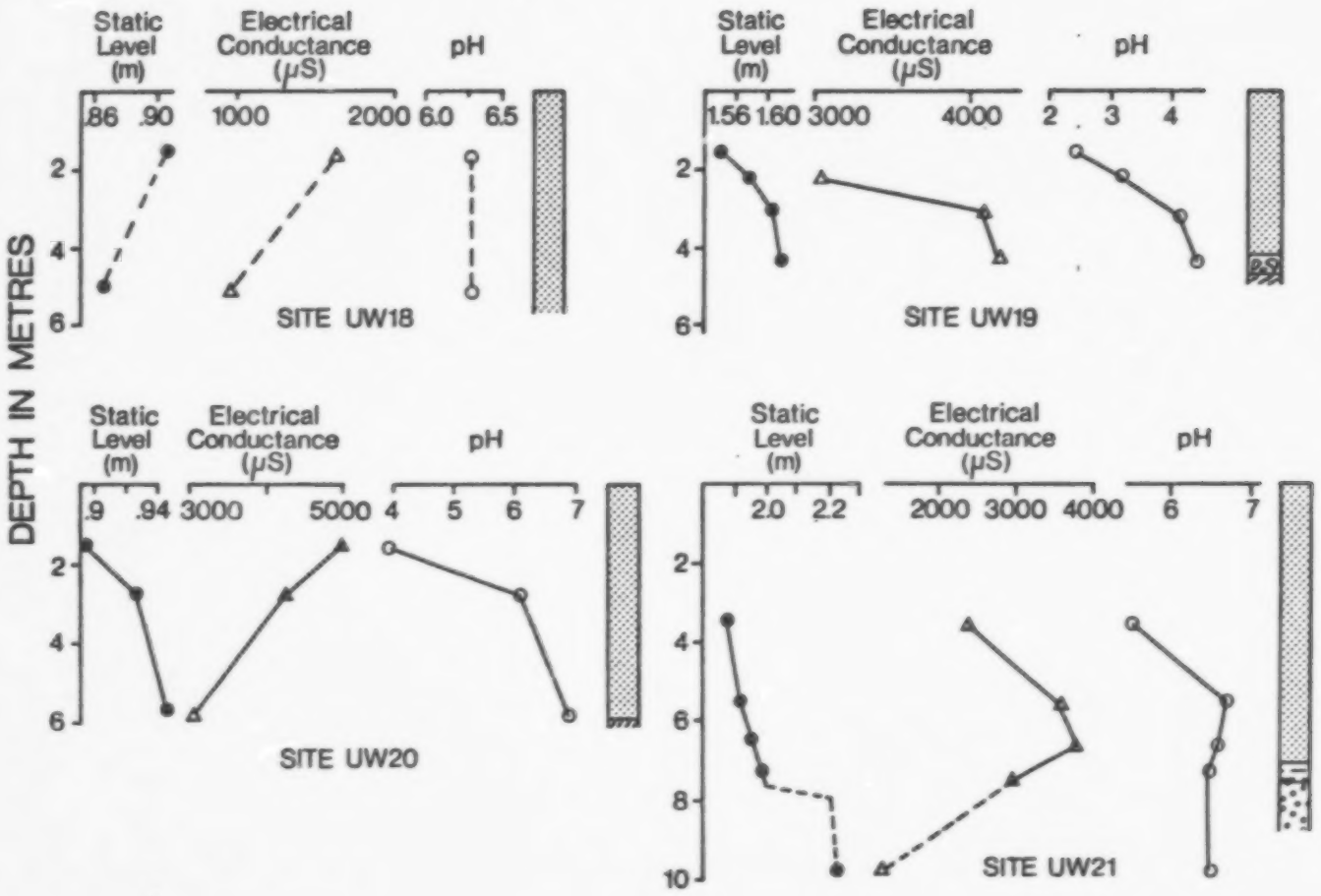

Figure D6 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW18, UW19, UW20, UW21.

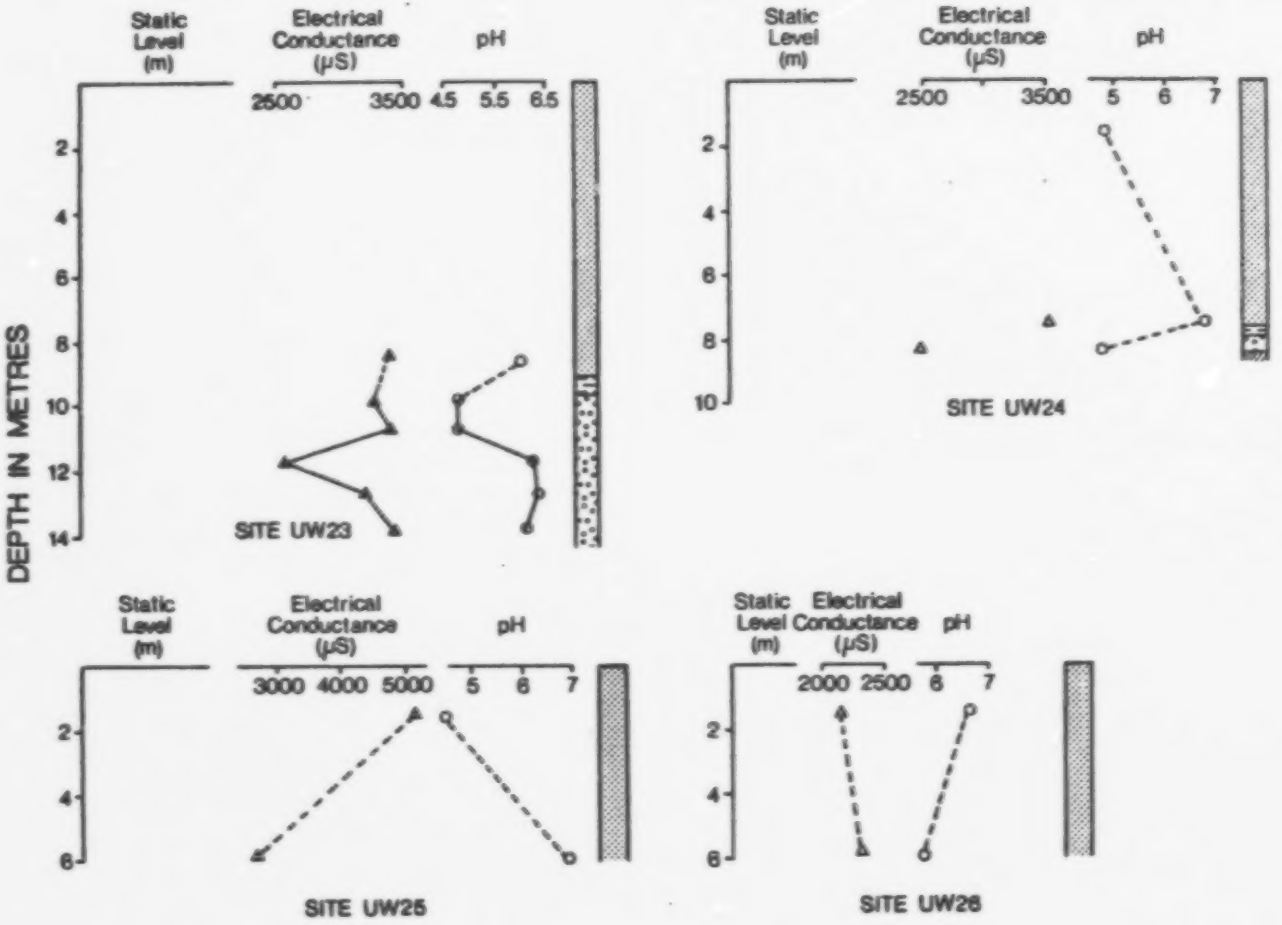

Figure D7 - Static Level, pH, Electrical Conductance vs. Depth For Sites UW23, UW24, UW25, UW26.

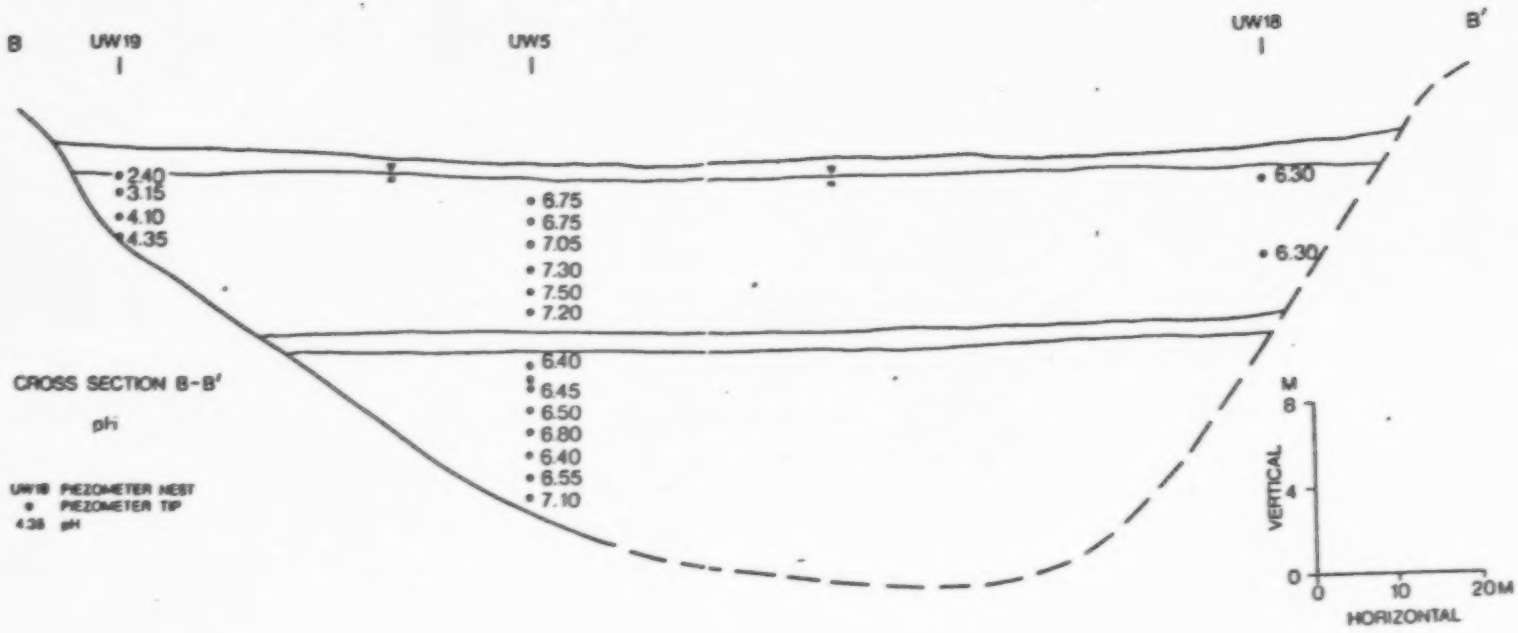

Figure D8 - pH, Cross Section B-B'.

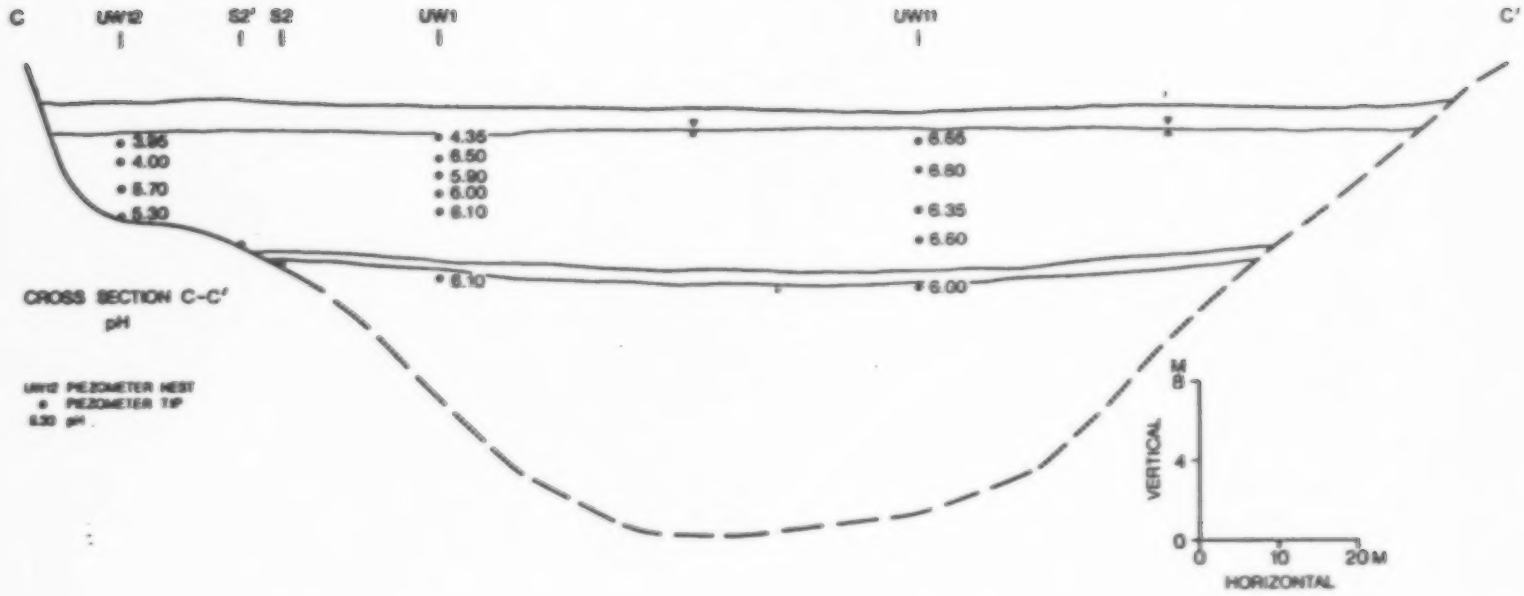

Figure D9 - pH, Cross Section C-C'.

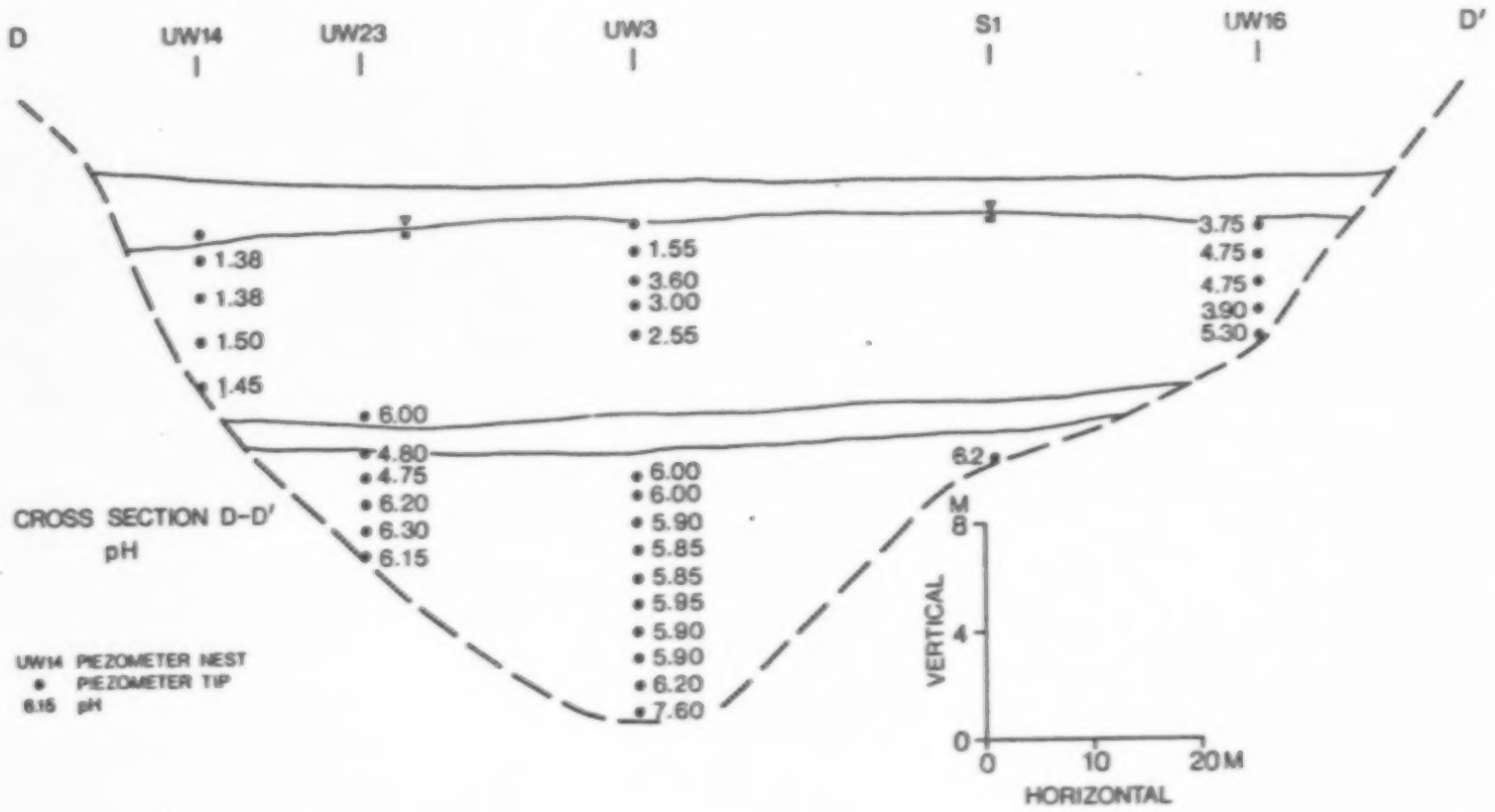

Figure D10 - pH, Cross Section D-D'.

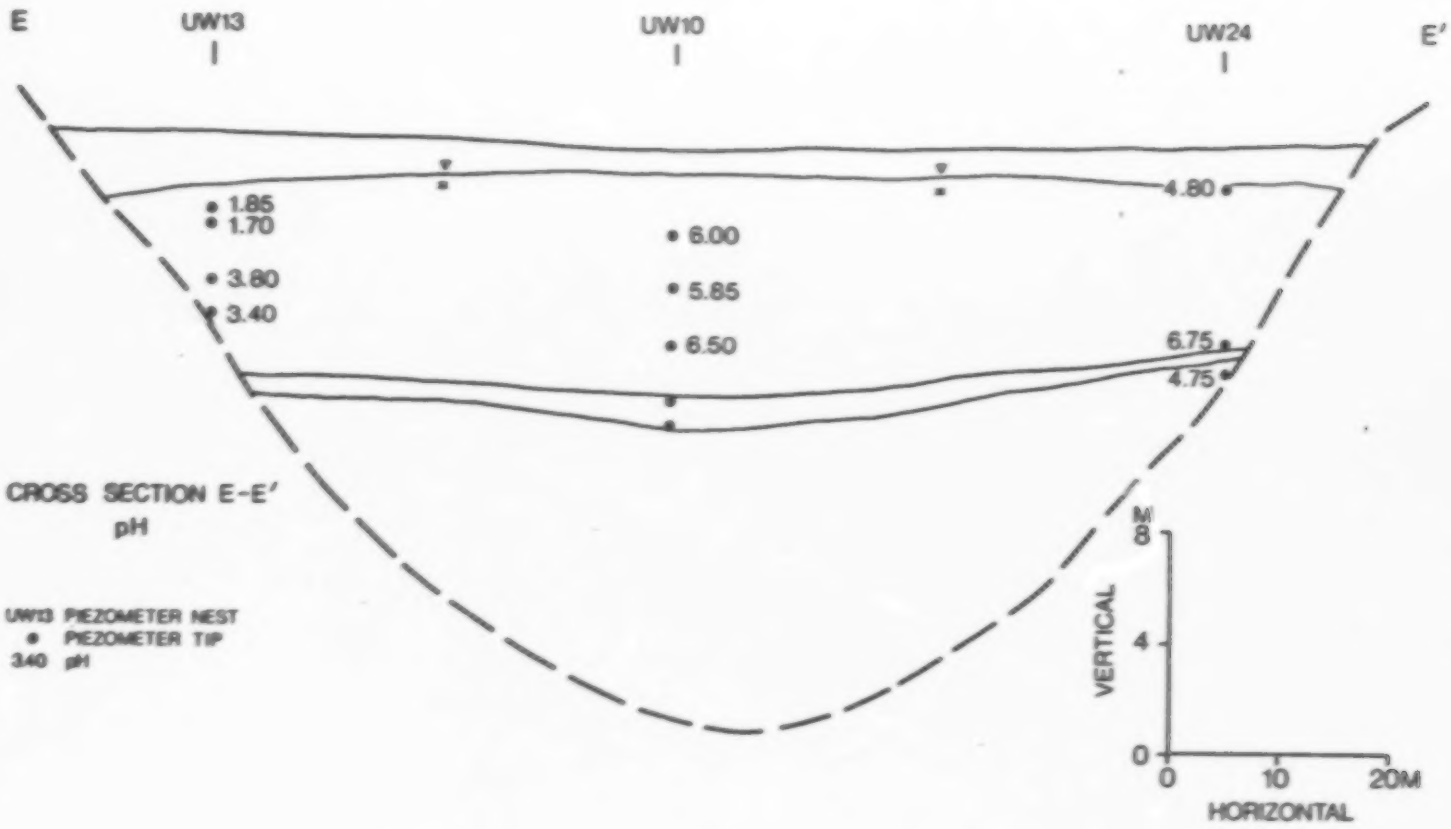

Figure D11 - pH, Cross Section, E-E'.

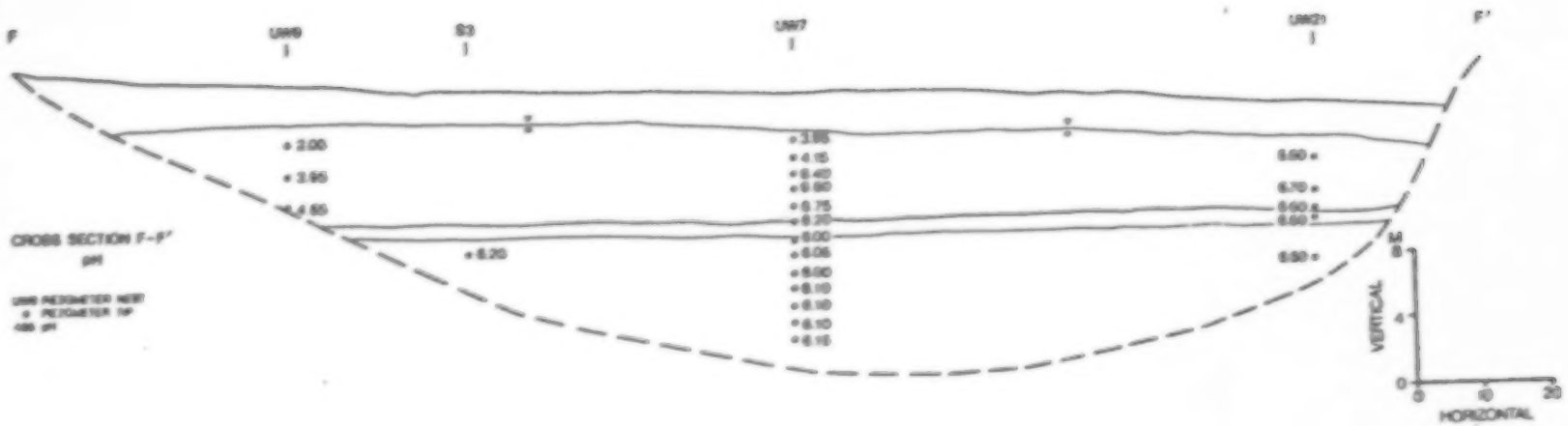

Figure D12 - pH, Cross Section, F-F'.

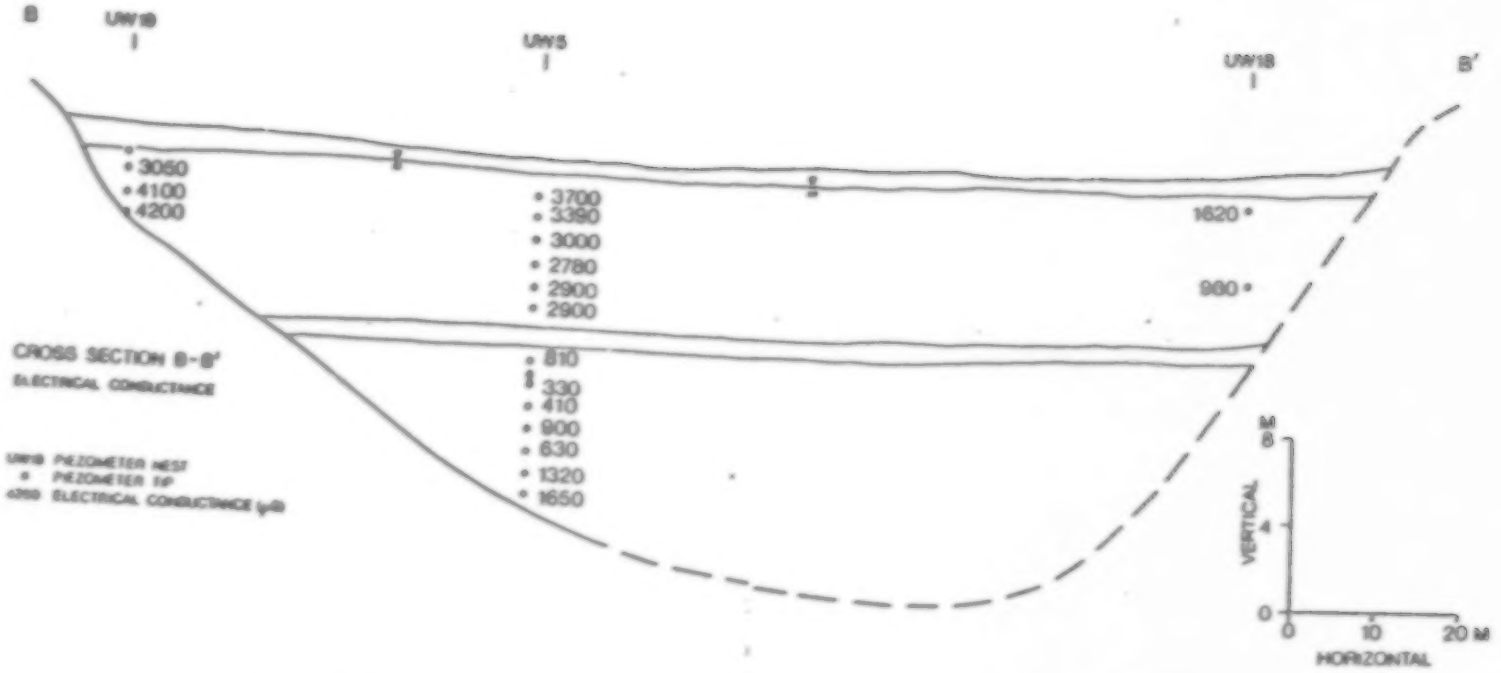

Figure D13 - Electrical Conductance, Cross Section B-B'.

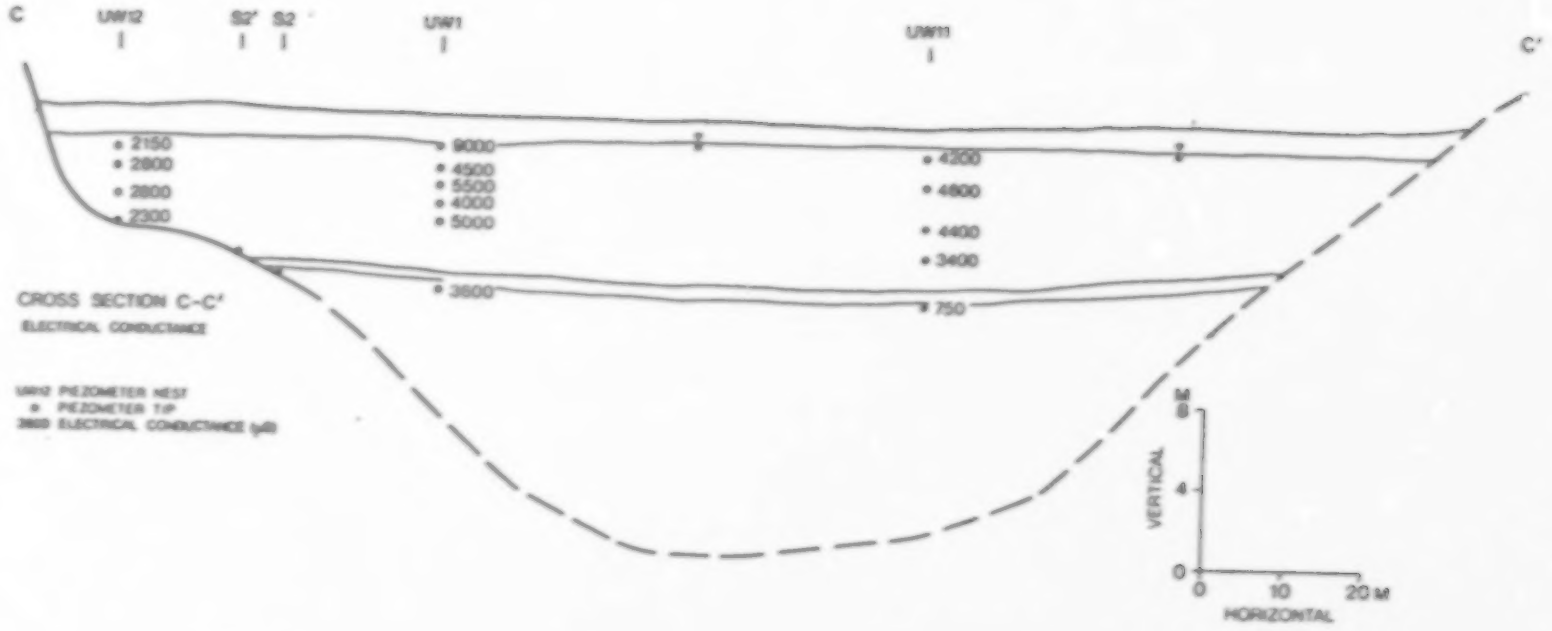

Figure D14 - Electrical Conductance, Cross Section C-C'.

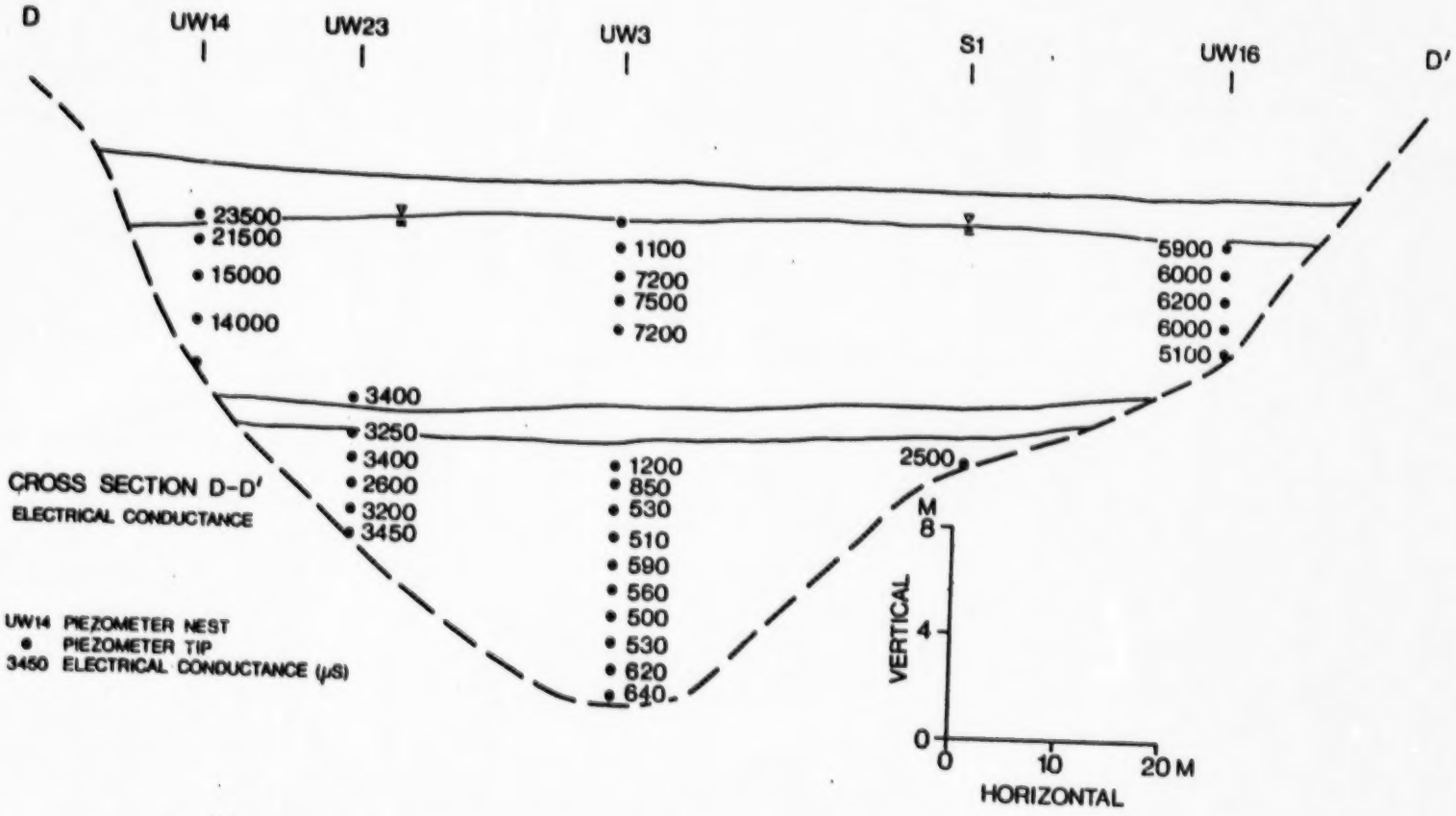

Figure D15 - Electrical Conductance, Cross Section D-D'.

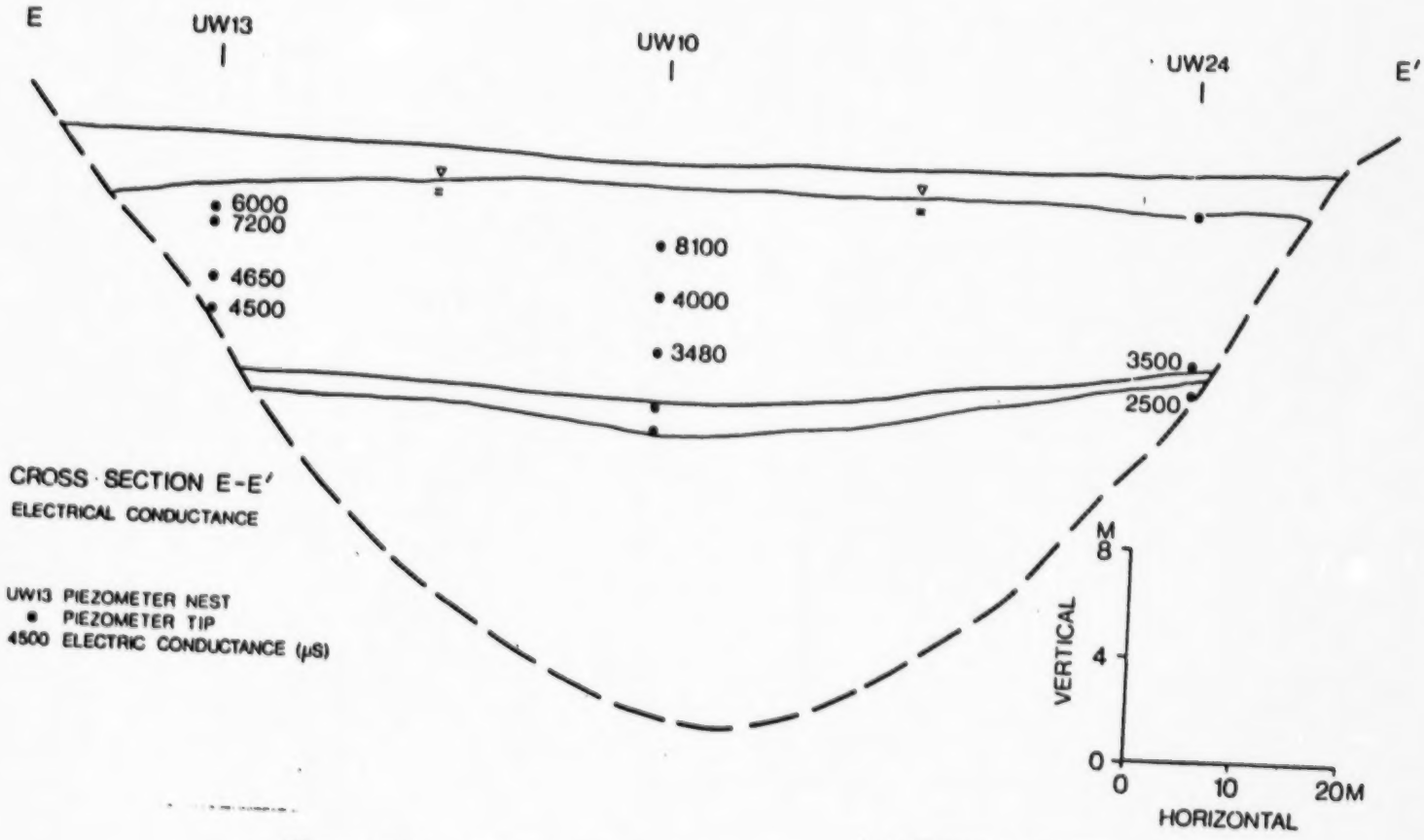

Figure D16 - Electrical Conductance, Cross Section E-E'.

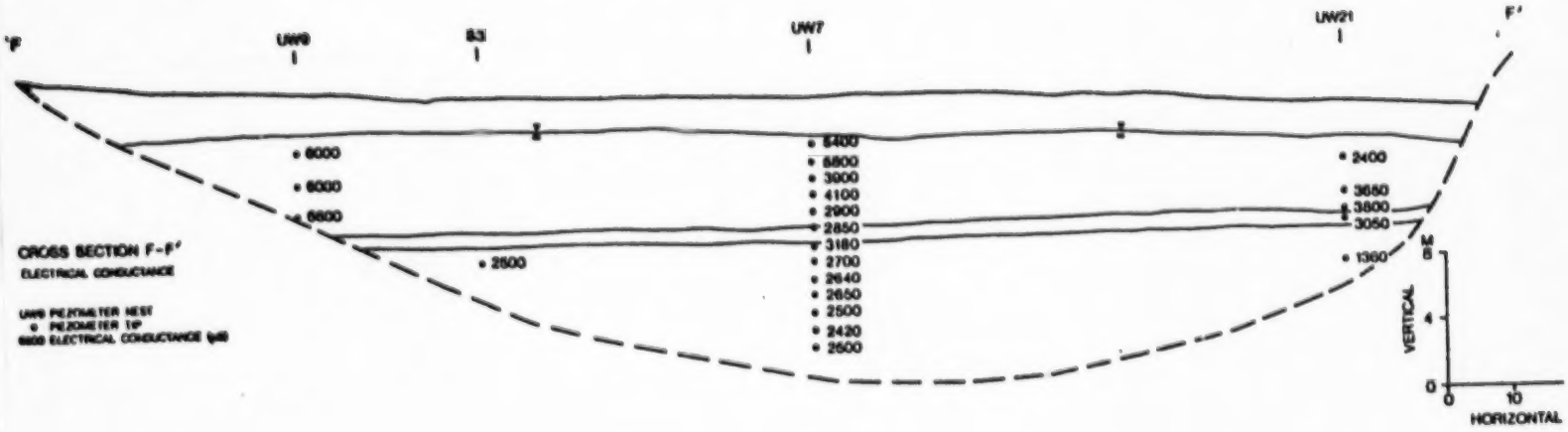

Figure D17 - Electrical Conductance, Cross Section F-F'.